ELECTRICAL REVIEW

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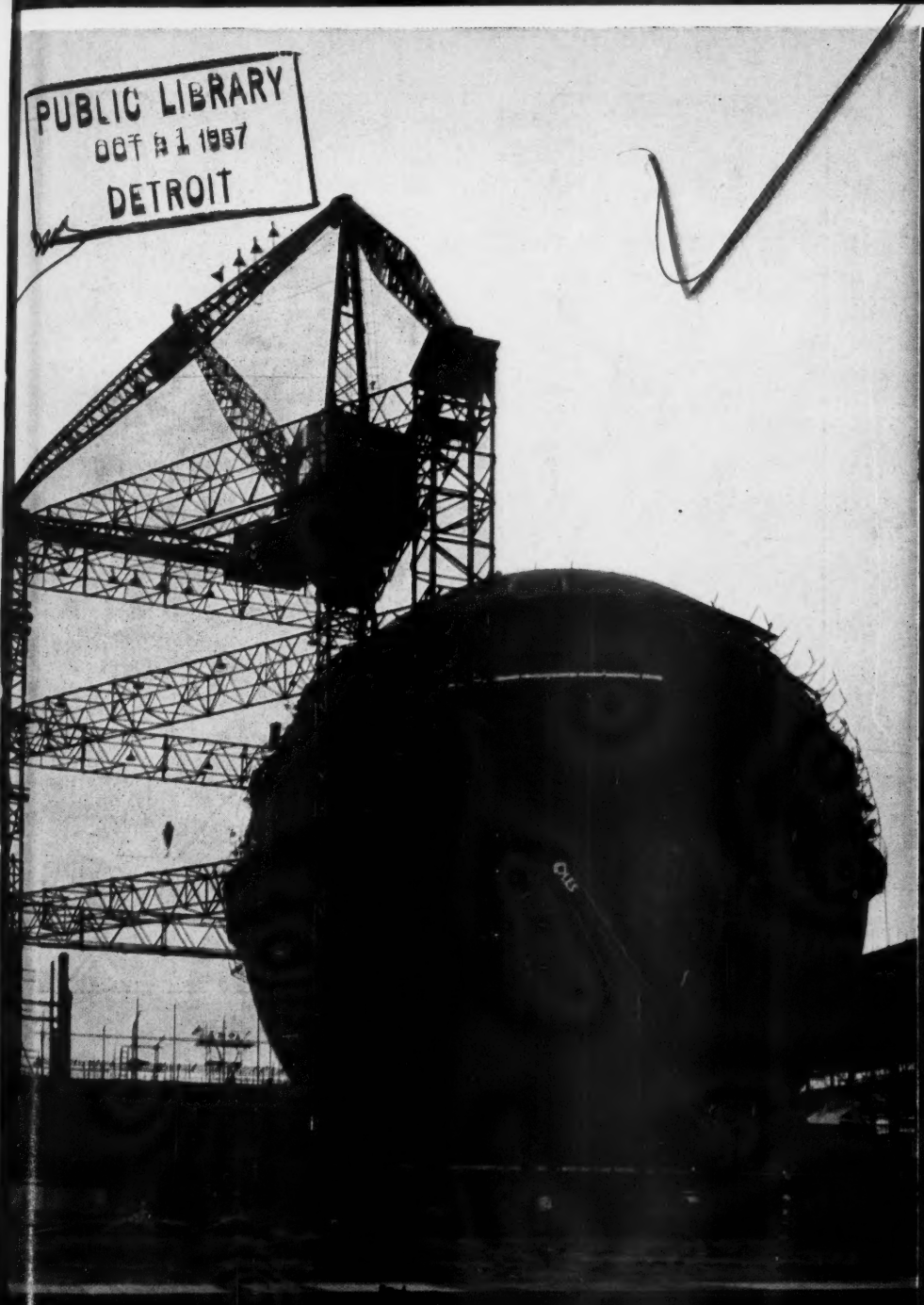

Shaping the pattern of the nuclear future

Two nuclear power projects of global significance have been undertaken by the G.E.C.—Simon-Carves Atomic Energy Group. In Scotland, the Group is to construct a 320 MW nuclear power station for The South of Scotland Electricity Board. At Dounreay, The Motherwell Bridge and Engineering Company Ltd. (a member of the Group) is building the 135 ft. diameter reactor-containing sphere for the U.K. Atomic Energy Authority's fast breeder reactor. The G.E.C. is installing the electrical generating plant.

G.E.C.
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SIMON-CARVES LTD.
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Prestressed Spun Concrete Lighting Columns

All Stanton Group 'A' Columns are acceptable to the Ministry of Transport for use on trunk roads.

Part of an installation of Stanton type 8 prestressed spun concrete lighting columns in Leeds City centre.

The type shown is part of a wide range of Stanton designs approved by the Council of Industrial Design.

Photograph by courtesy of L. A. Doxey, Esq., Public Lighting Engineer

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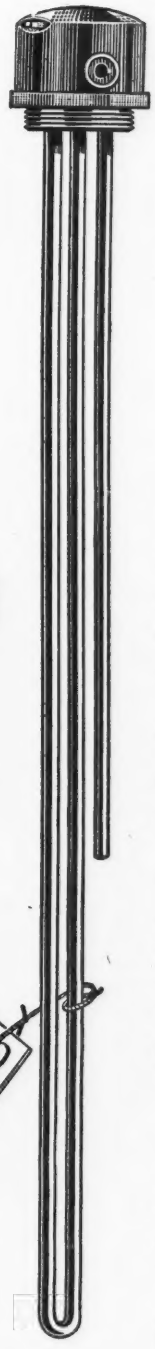
we don't want to be Big Headed about it -



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But, the **'SLIMROD'S'** crowning glory is its head — and the reduction in size of the terminal cover which has a projection of only 2½".

Our **Leaflet No. 81** gives a lot of helpful information about the **'SLIMROD'** — Ask us to send you copies.

* **HEAD NOTE:** *We are asked how it is that we remain so modest about such a remarkable achievement. Perhaps it is that we are accustomed to repeated high praise and refrain from letting it go to our head — except as a spur to even better things . . . !*

Manufacturers of: Electric Water Heaters, Oil Heaters, Immersion Heaters, Urns, Towel Rails, Airing Cupboard Heaters, Flameproof Heating Apparatus, Breakfast Cookers, Electric Fires, Food Trolleys, Warming Plates, Air Heaters, etc.

A

limit switch

For all heavy duty limit switch applications, particularly those to withstand conditions of extreme severity, there is a suitable B S A — ACME SNAP-LOCK of either water, oil and dust proof or flameproof versions. The superiority of this switch is due largely to the simplicity but ruggedness of its mechanical and electrical units contained in seperate compartments within a robust housing. Unique Snap-Lock design ensures self-wiping quick make and break, positive contact, maximum resistance to wear, and accurate repetitive tripping.

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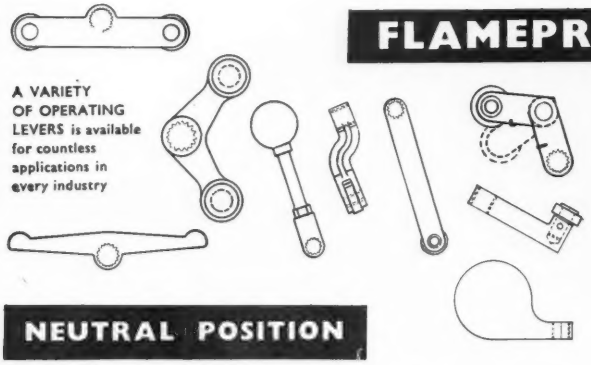

A VARIETY OF OPERATING LEVERS is available for countless applications in every industry

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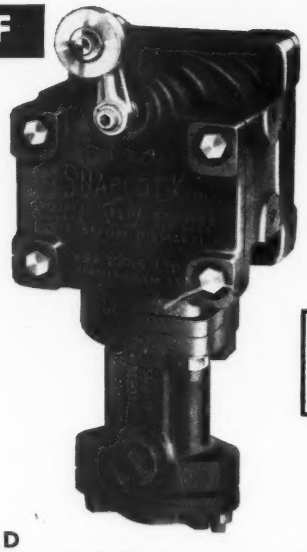

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FLP
No. 3574
Group 1
No. 3575
Group II & III

NEUTRAL POSITION

These limit switches are now available in Neutral Position versions. Spring-loaded devices return the operating lever to the central (neutral) position. One or both of the springs are removable for various circuit arrangements. A third spring is supplied for converting to one normally made and one normally broken circuit.

STANDARD

Single pole, double break, double throw, operates with either circuit normally open with other closed, or maintaining in either position, or available with central neutral position: return springs removable for various circuit arrangements. Heavy die-cast case. Water, oil and dust proof. Conduit ¾" in. B.S., or No. 3 Admiralty Pattern Cable gland entry. Two screw side mounting or backplate mounting in two styles, or Tandem style (back to back mounting). Operating lever position adjustable in 7·5 deg. increments through 82.5 deg. either way from normal. Levers for a variety of applications.

FLAMEPROOF

Buxton certificates No. 3574 (Group I) No. 3575 (Groups II and III gases). Meehanite iron castings. Self wiping solid silver contacts. Interchangeable plugs and sockets. Internal mechanism removable as a unit for servicing. **Single SWA cable entry (standard); double entry if required.** Operating lever position adjustable in 7.5 deg. increments through 360 deg. Levers for a variety of applications. **TYPE HLB**: Single pole, double break, having one normally closed and one normally open circuit — reversible by transferring the return spring. Return spring removable for external manual operation. **TYPE HLB/NP:** Single pole, double break, double throw, with central neutral position. Return springs removable for various circuit arrangements.

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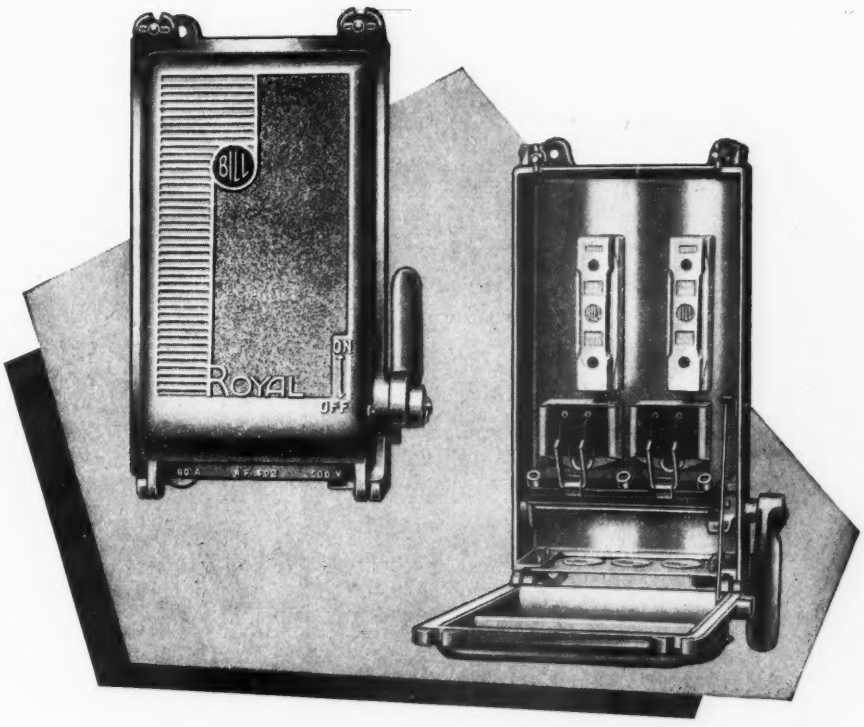

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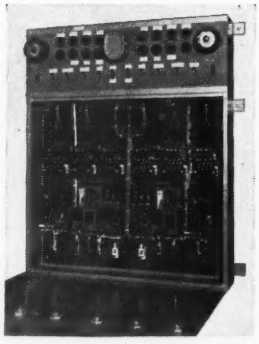
More and more firms who require electrical control schemes to operate their plant find it helpful to discuss their needs with a Hydra Engineer.

HYDRACONTROL design and layout is easily and economically tailored to suit any control sequence and the finished panel, completely wired during construction, gives a professional finish and distinctive touch to the job.



The hidden advantages of HYDRACONTROL panels include

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HYDRACONTROL Panels are designed for wall fixing or free standing.

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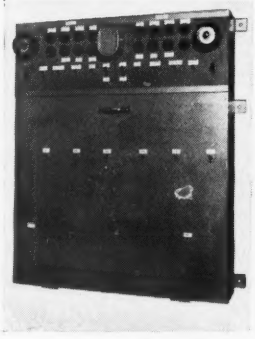

The panel shown above controls two Cochran No. 19 boilers, each having two Major Burners. The panel houses the oil pump starters, heater contactors, burner controls, electronic flame devices, high/low water alarm system, manual and automatic flame control and indicator lights showing the Boiler condition at a glance. Visual and manual alarms are incorporated in this fully automatic plant which is completely controlled by time-clocks.
This Hydracontrol unit was made for Porth Textiles Ltd.

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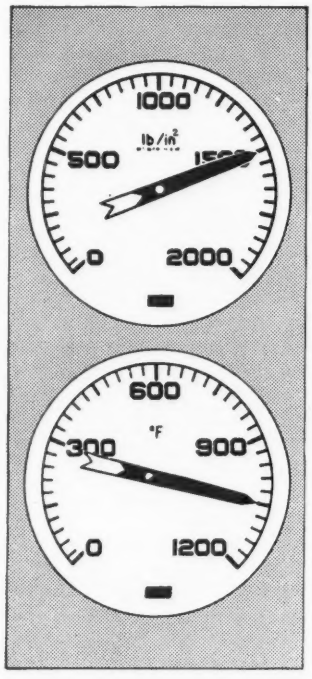

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These are the exacting steam conditions at C.E.A.'s new Meaford 'B' Power Station—a measure of the advanced design of the four BTH 60-MW hydrogen-cooled turbo-alternators already installed there and on order.

Turbo-alternators by

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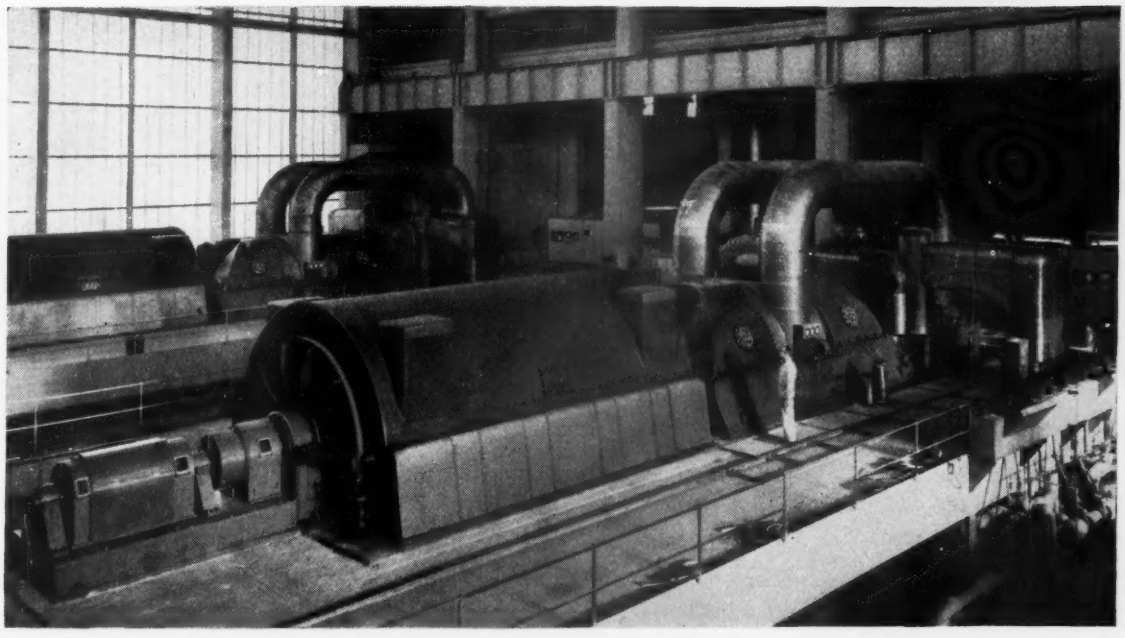

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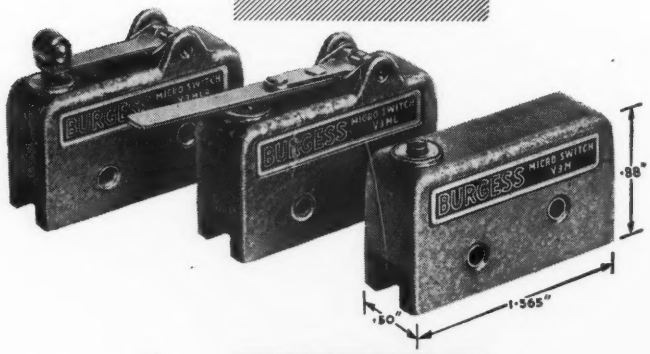

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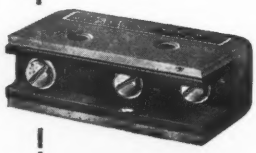
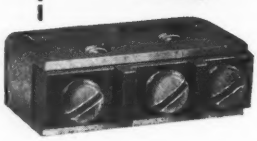


Two Types of Terminal Arrange-ments



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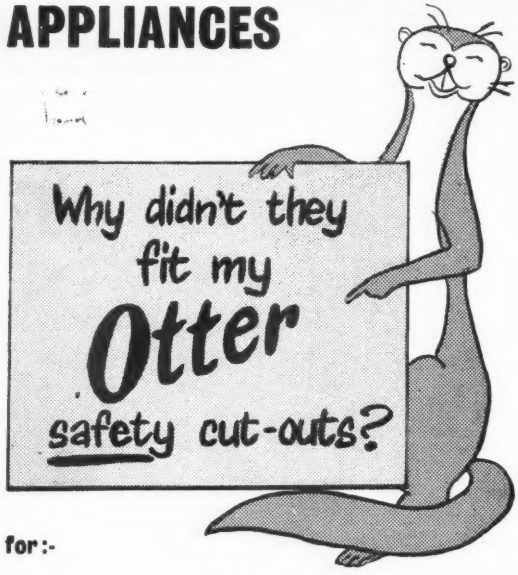

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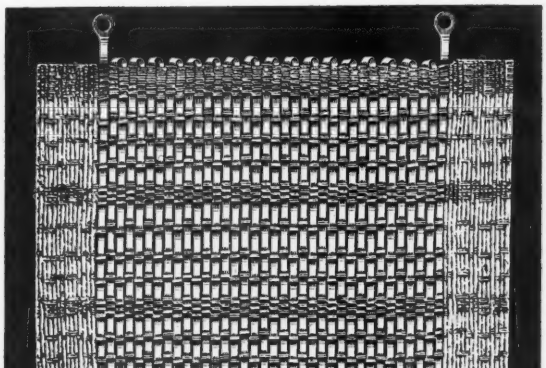

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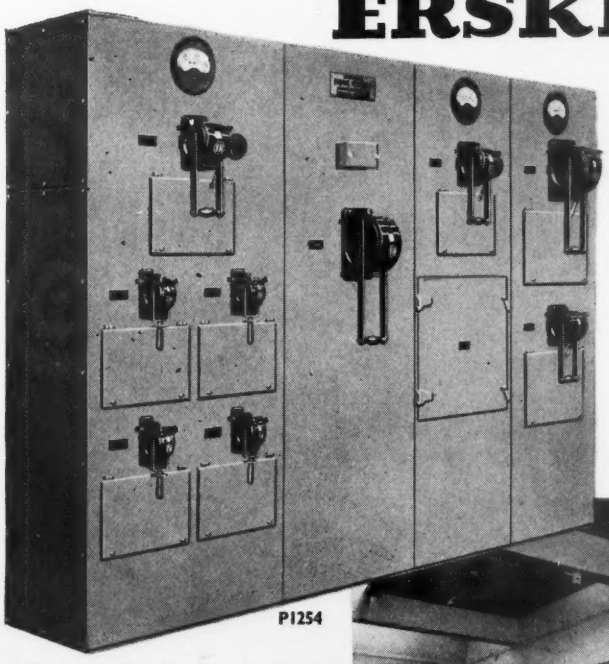
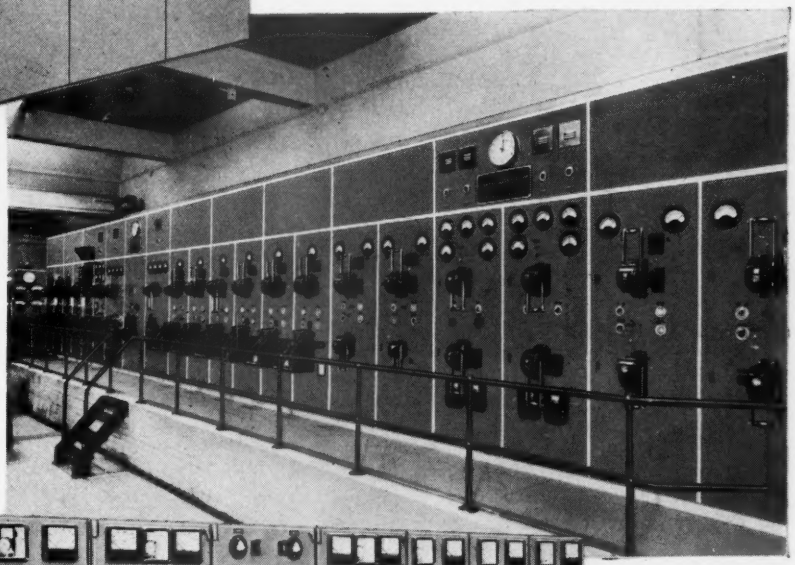


P1254 One of several Switchboards supplied for big new Lancashire School. This switchboard comprises back-of-board type switches, fuses and contactors with front-of-board operation.

P1256 Illustration shows main switchboard controlling power and lighting at Manchester College of Science and Technology. Switches are of 25 MVA rupturing capacity, tested to BS.116 at 400 volts. Duplicate bus bars are provided with front-of-board operated changeover switches for changing over between the College's own Turbo Alternator set and Electricity Board.



P1256

P1263 Switchboard illustrated below is one of several supplied recently to control the power and lighting of the Chemistry & Engineering Building, Queen's University, Belfast, the two incoming units and bus bar coupler being 1600 amp. capacity.

P1263

ERSKINE, HEAP & Co LTD

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Top left: A basic unit showing the ample wiring chamber.

Top right: A capacitor assembled from basic units and a few simple parts.

Below: The simple parts required for assembling units into banks.

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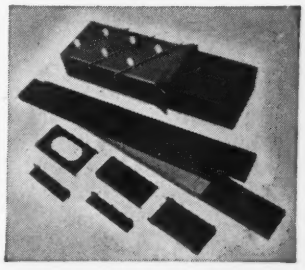
The simplicity of design has resulted in a small, space-saving capacitor; easy to assemble.



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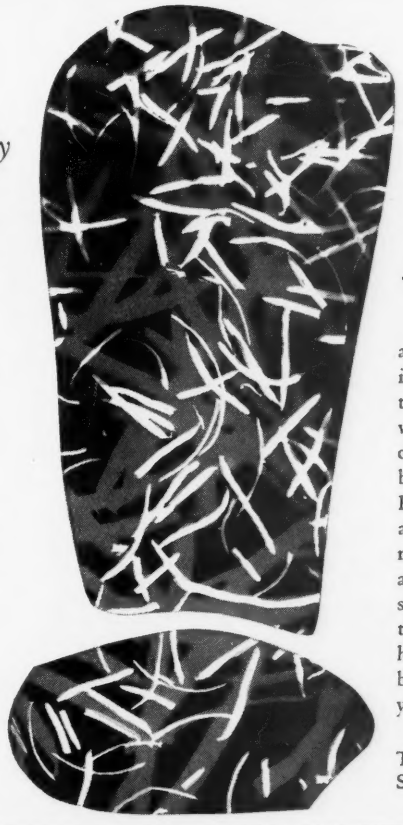

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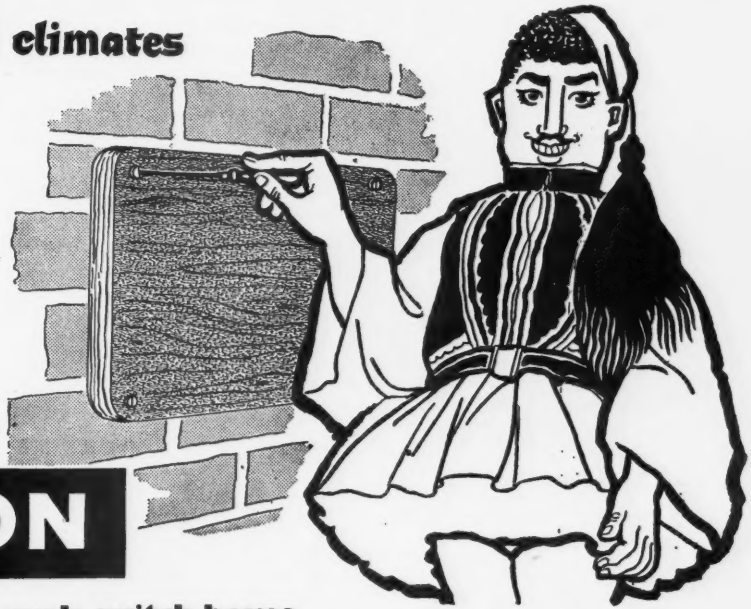

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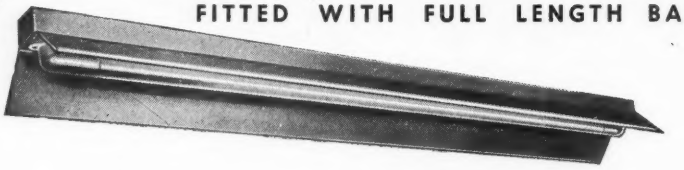

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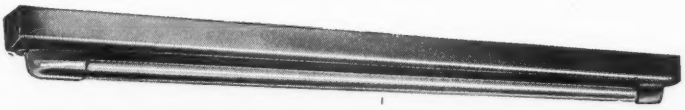

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Precision Instrumentation

The Turner range of contemporary square instruments have the same high level of electrical precision and can be interchanged with their round counterparts using the same fixing holes. They are flush fitting, no fixing is visible from the front; offered as moving coil, rectifier, thermo-couple, moving iron and electrostatic, with larger scales for easier, clearer reading and standard sensitivities as high as 10μA.

Model 325 moving coil 0—50μA 3" square, scale length 2$\frac{3}{4}$", interchangeable with Model 505 round instrument, flush mounting and no fixing visible from the front.

Full details of these and other Turner instruments—transformers, shunts, resistances and specialised stroboscope equipment—are given in Catalogue No. 85 which is available on request

Ernest Turner Electrical Instruments Ltd.

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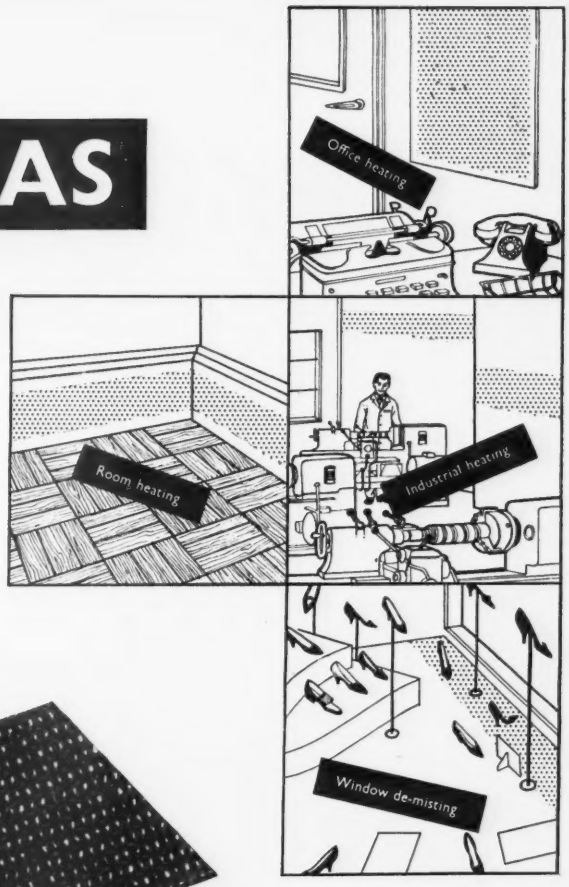
Introducing–

MHOGLAS

The New Non-metallic Heating Element

Mhoglas is a completely new departure in the area-heating field—new working principle, new materials, new manufacturing techniques. Its many qualities, particularly its complete safety, make it an attractive proposition for the space heating of buildings. Here the element could be incorporated in floors, walls or skirting boards or even in wooden, plastic or rubber panels.



Some Mhoglas features

1 Provides even, "solid" heat without hot spots or tracks.
2 It is light, flexible, non-metallic and made in thin sheets.
3 Can suffer local damage without element failure and is thus inherently "safe."
4 May be shaped, cut and formed, potted, laminated, and incorporated in wood, plastics, rubber, concrete and metal.
5 May be curved to radii of 1½" or as low as ¼" during manufacture.
6 May be thermostatically controlled, directly or remotely.

Mhoglas can be supplied in all lengths and in widths up to 12"

It is produced and marketed by Hunting Mhoglas Ltd. who welcome your enquiries.

HUNTING MHOGLAS LIMITED

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AP/10

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Wire in all sizes and diameters to fulfil every physical requirement from soft- to hard-drawn. Rods and bars in high temper for machining purposes or soft for cold stamping. Strips for all kinds of blanking and cold drawing operations. Strand for overhead lines and for electric cables.

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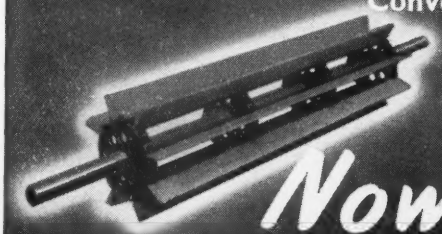

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complete in combination with our

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which can be fitted by simply bolting to existing structure.
Micro-adjustable. Flameproof.
Anti-static features can be incorporated.
Little, if any, guarding required.

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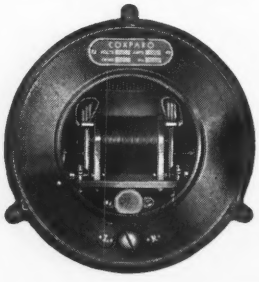

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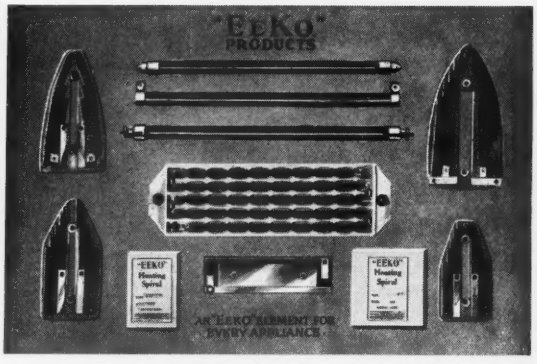

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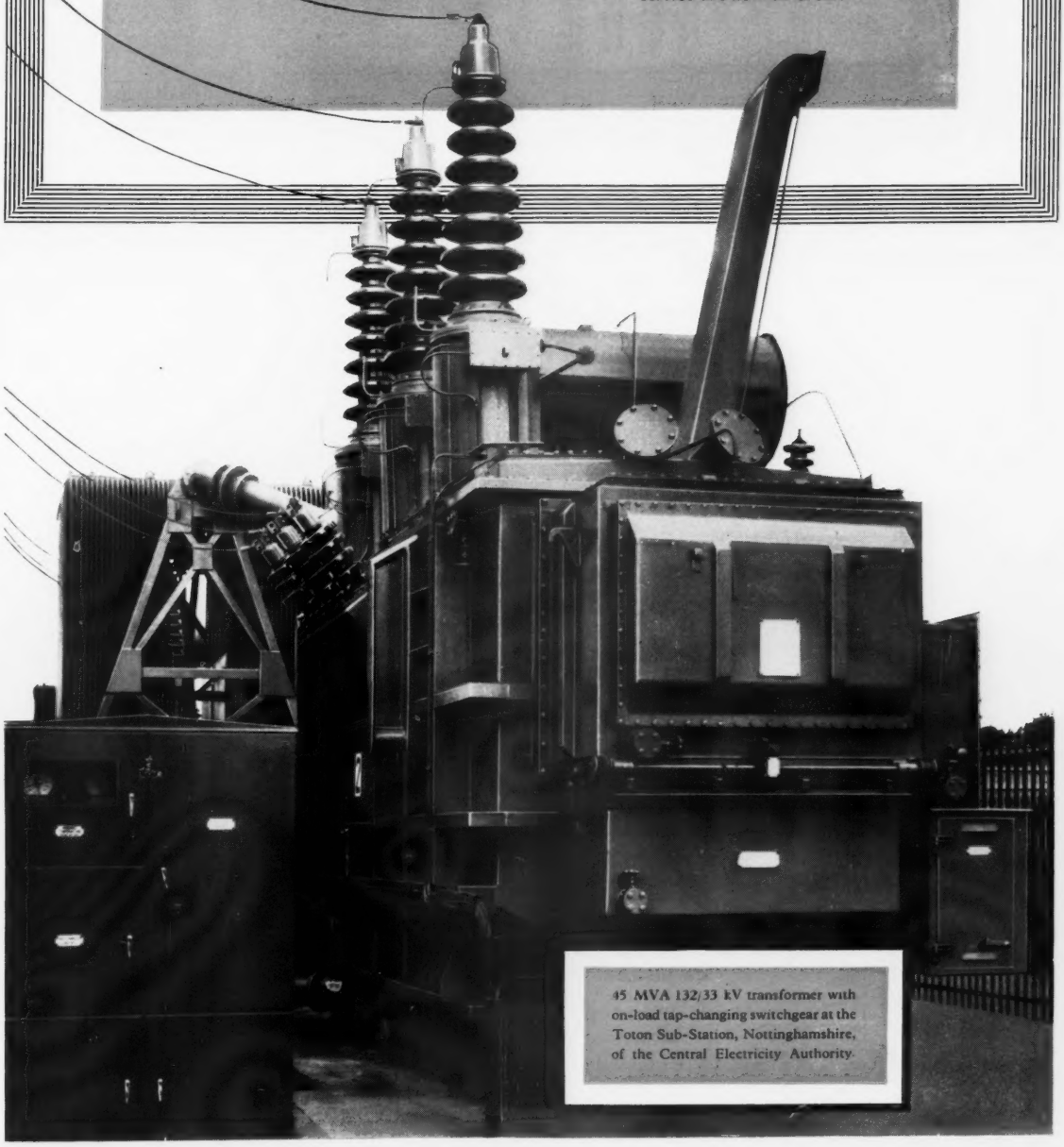

45 MVA 132/33 kV transformer with on-load tap-changing switchgear at the Toton Sub-Station, Nottinghamshire, of the Central Electricity Authority.

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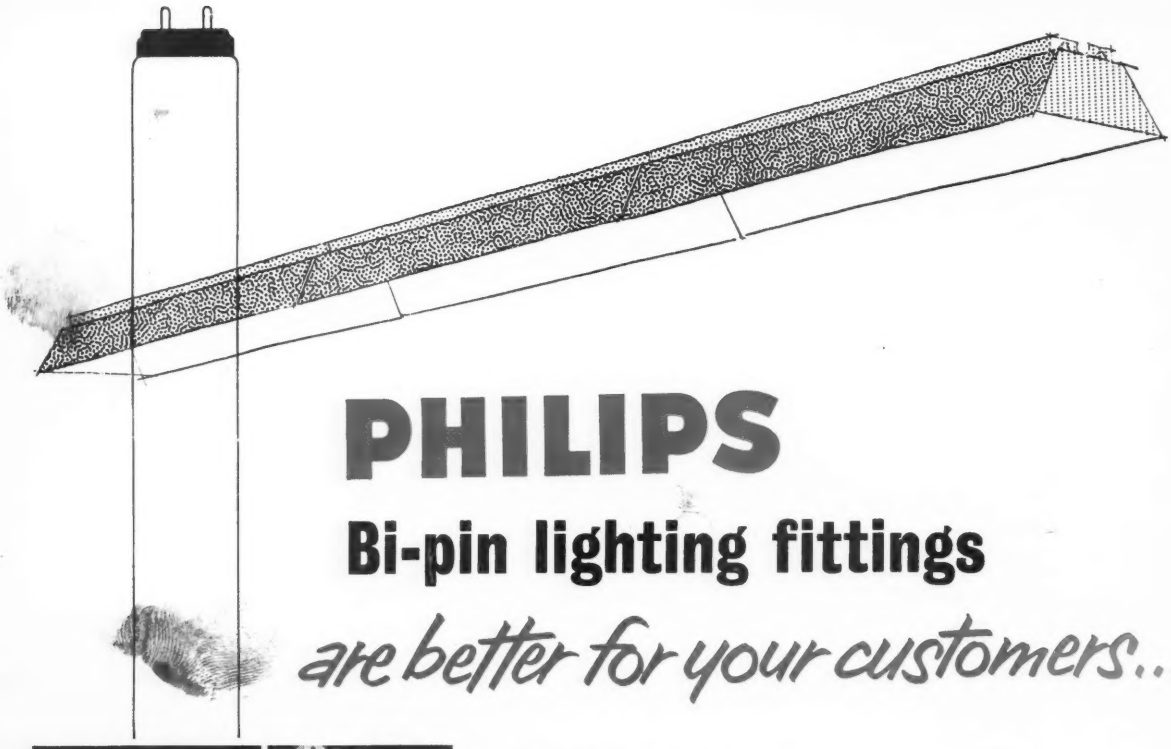

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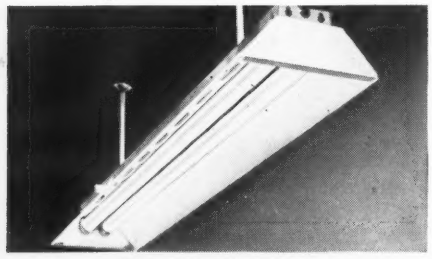
Bi-pin lighting fittings

are better for your customers...



TK13 Industrial Fittings

TB17 Commercial Fittings (*made in Holland*)

Philips Bi-Pin Lighting Fittings are news. Here's why:

- ✳ They're simple, compact, light in weight.
- ✳ They incorporate the new Philips Polyester ballast, designed to deliver correct watts to the lamp, ensuring long life and maximum light output.
- ✳ They're ideal for both Industry and Commerce, and a wide range of fittings is available.
- ✳ They're standardised for 4′ and 5′ lamps to give a greater range of matching fittings.
- ✳ They can be arranged to provide a continuous stream of light.

...and for you!

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Order Philips Bi-Pin Fittings—available in 4 ft. or 5 ft. sizes—from your usual supplier or local Philips branch office. Expect demand to be considerable!

PHILIPS

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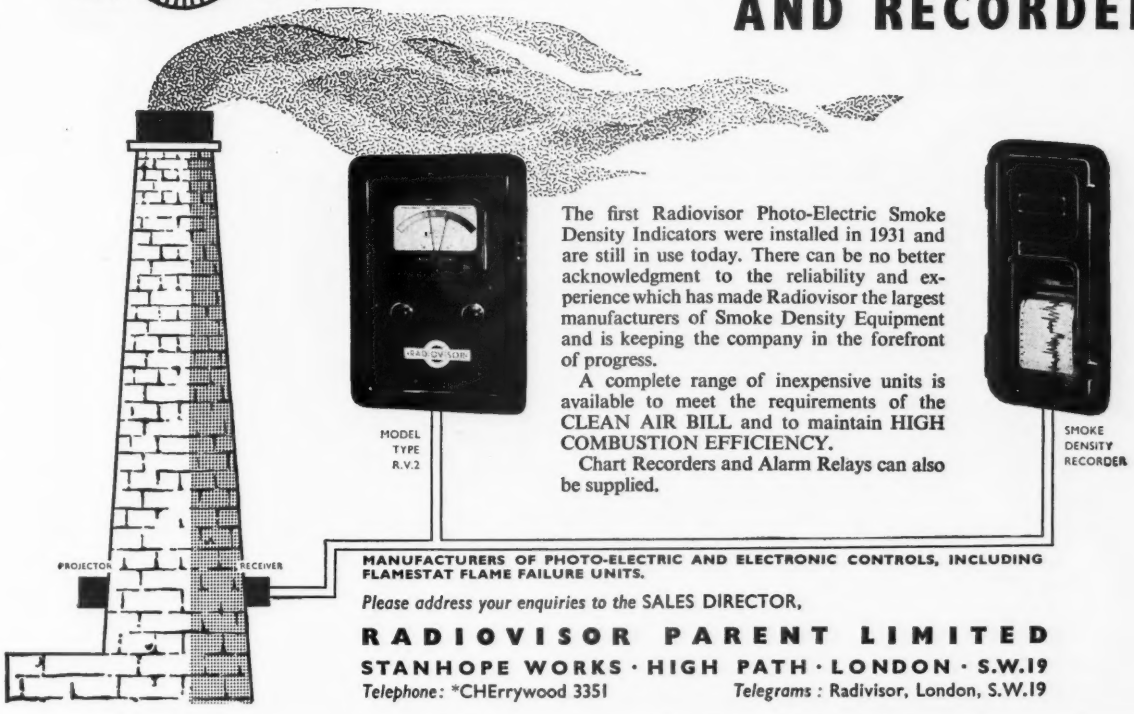

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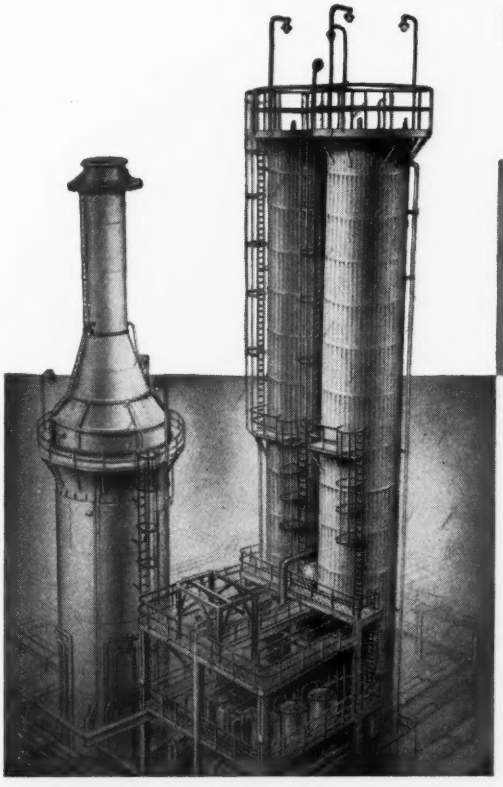

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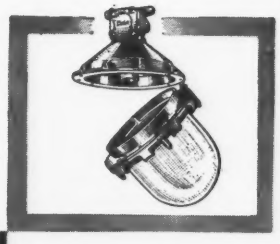

These unique Victor Lighting fittings are completely Weatherproof and Flameproof, and set new heights in efficient and economical lighting for exposed and completely unprotected conditions.

Our district engineers in your area would gladly welcome an opportunity to fully explain and discuss the system, and at the same time submit samples for your inspection. Please ask for Weatherproof/Flameproof catalogue L 600 or non-flameproof catalogue L 700.

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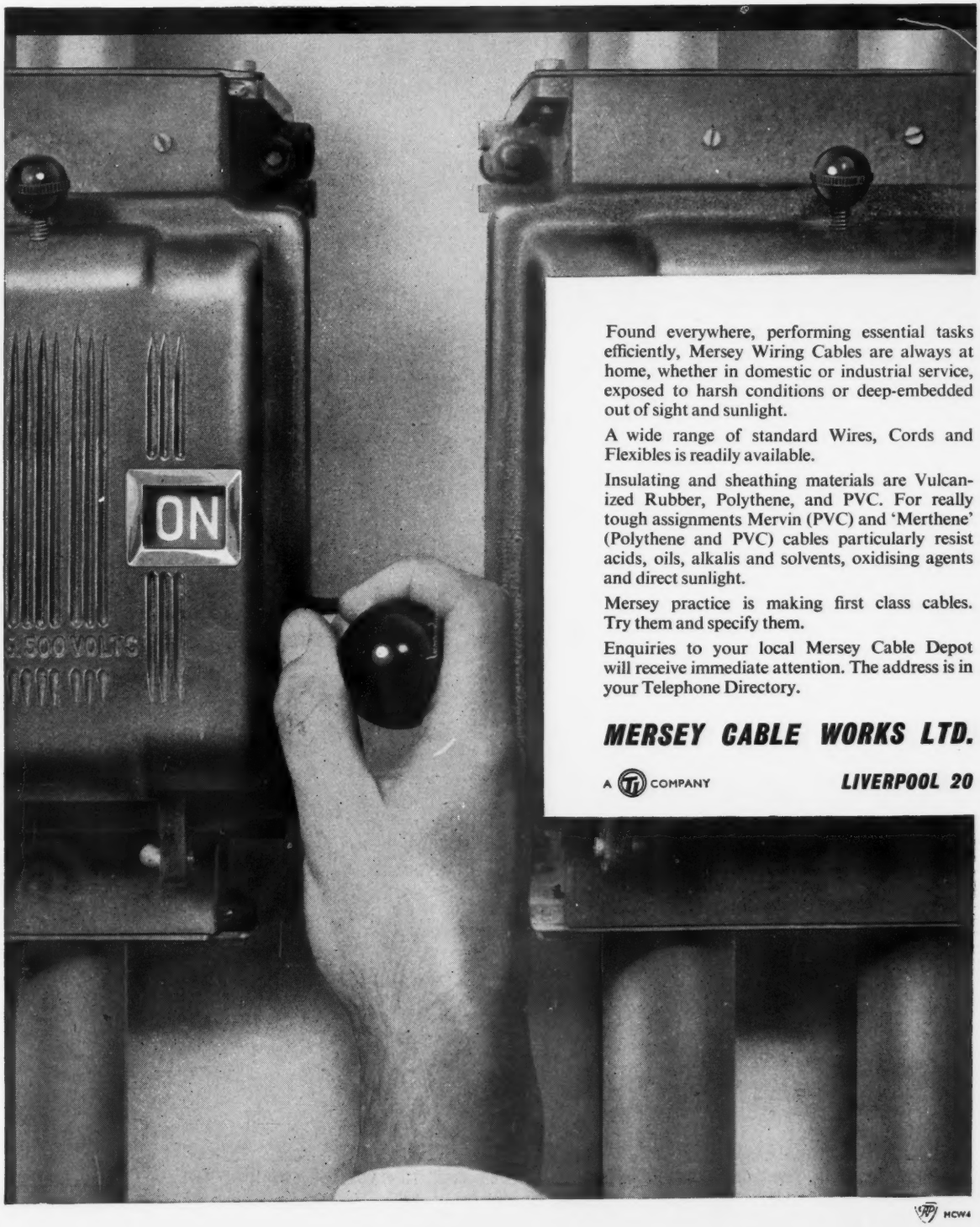

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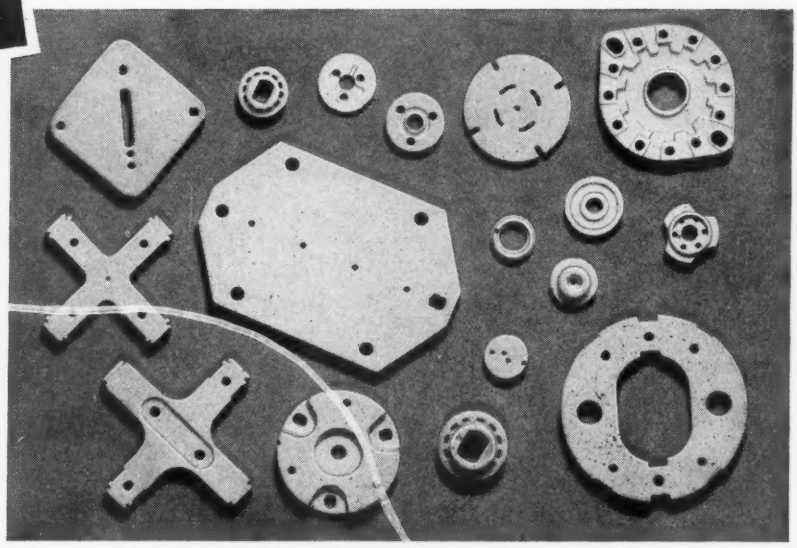

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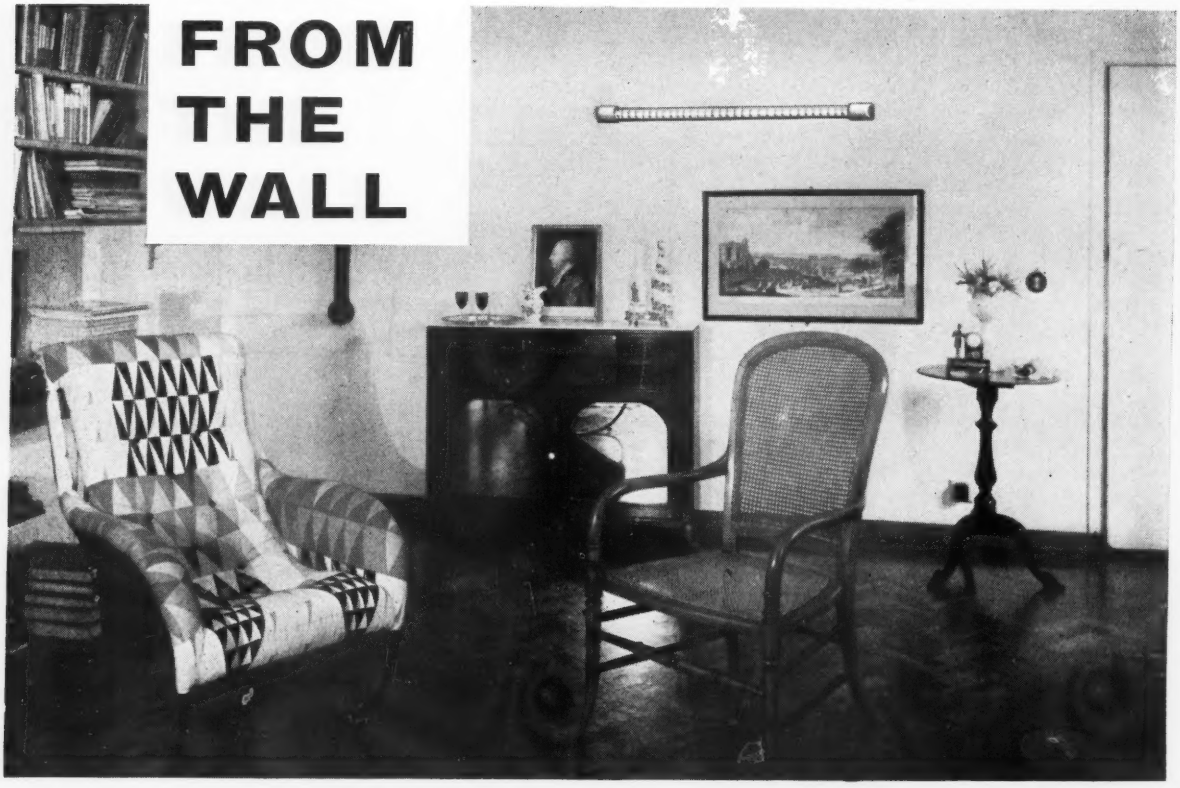
HEAT FROM THE WALL



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Available shortly at the retail price of 5 guineas, the new Ferranti 'Firestreak' is sure of a great welcome from the public. It has the advantage of keeping the floor clear and is therefore safer than the usual electric fire: it warms the whole room, so that the householder won't find his ankles roasting whilst his hands are still frozen. It is elegant, pencil-slim and colourful. Equally at home in the drawing-room, bedroom, kitchen, bathroom and nursery (Noddy transfers are available free for the end caps), the 'Firestreak', with its cheerful orange glow and gay appearance, is sure to be a firm favourite. And the price is well within the reach of the average household budget.

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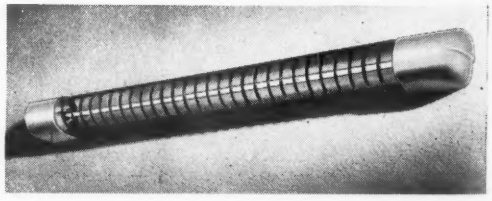
5 GNS

Including P.T. · available shortly



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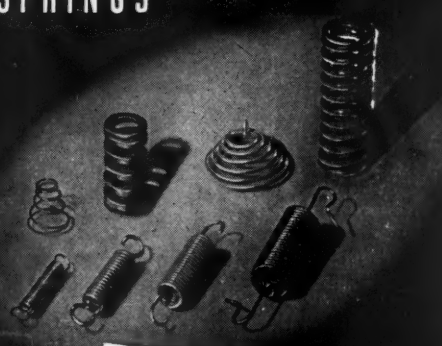

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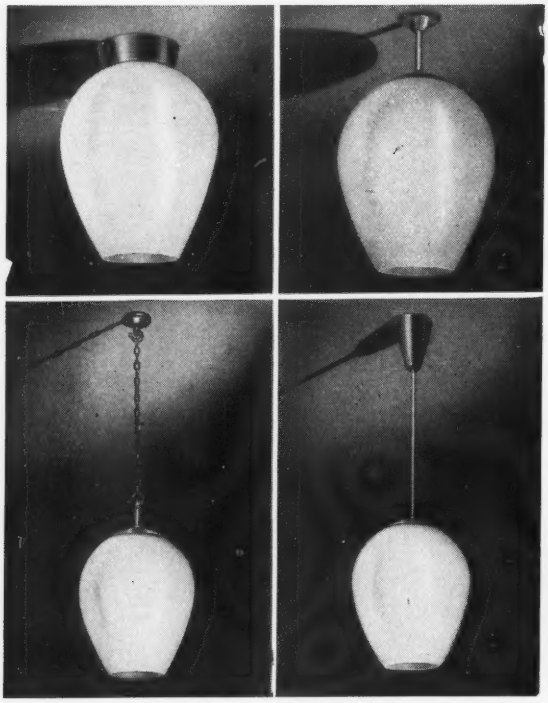

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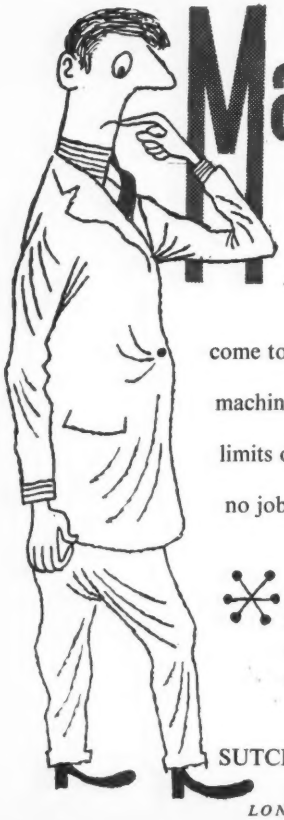

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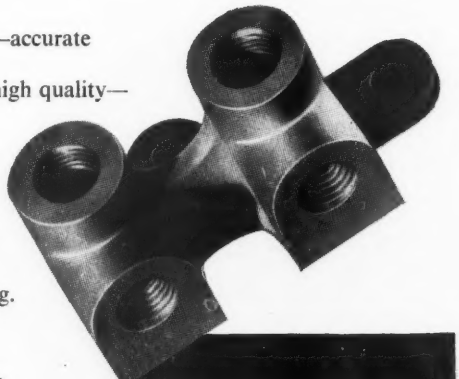

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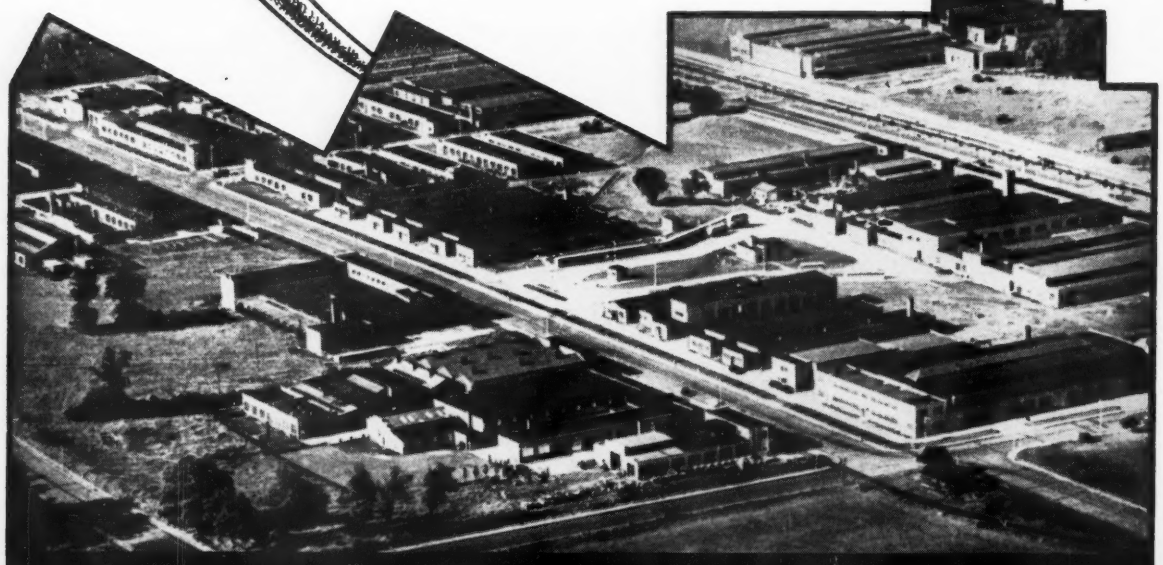

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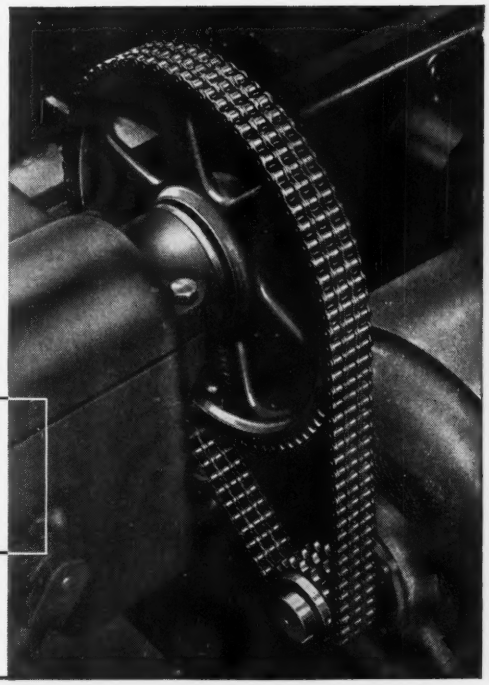

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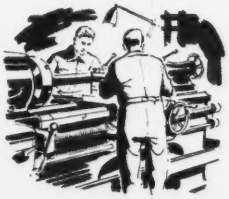

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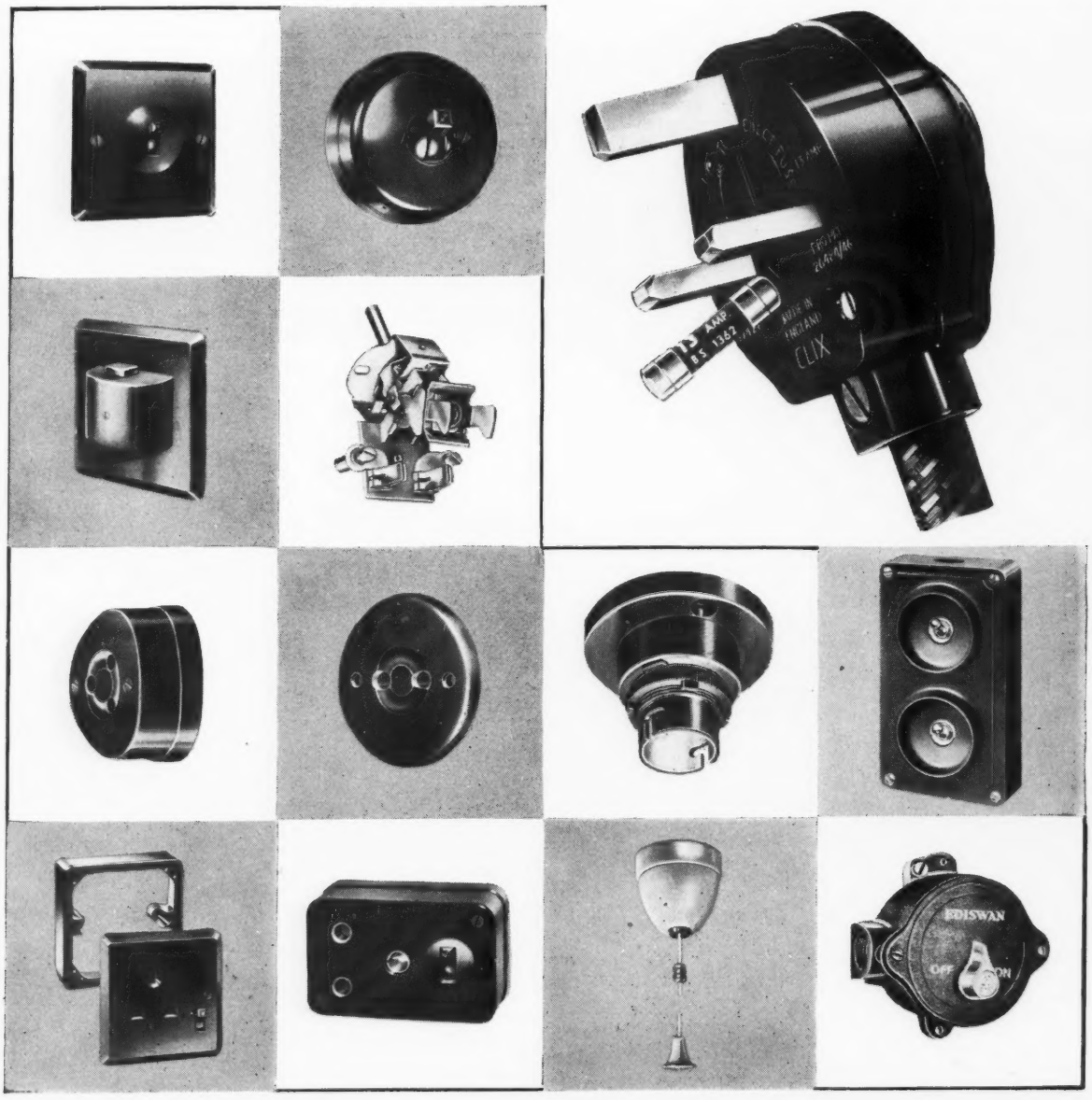

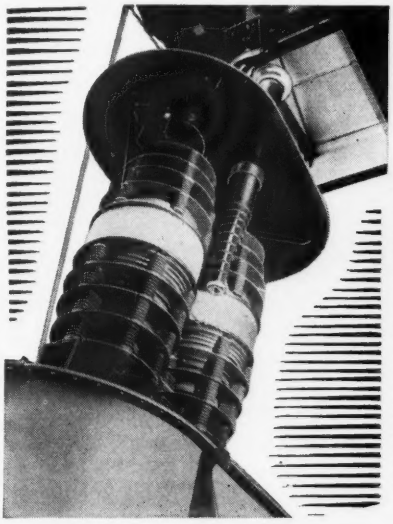

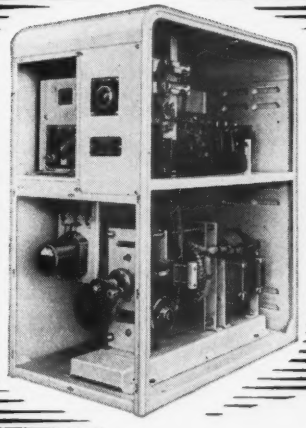

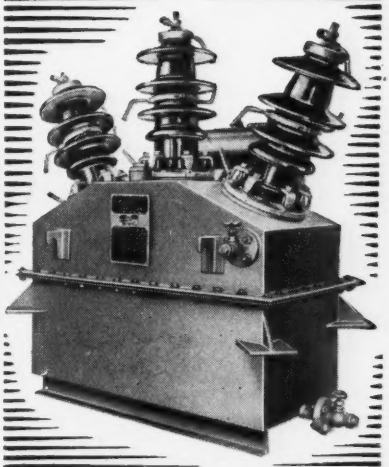

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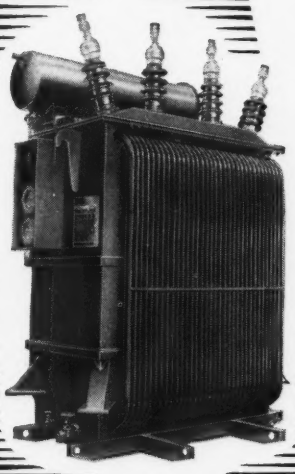

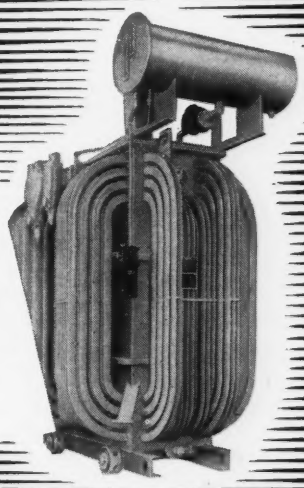

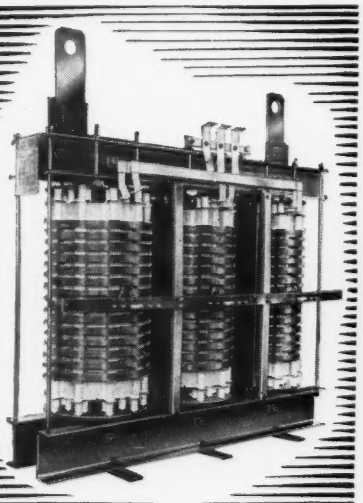

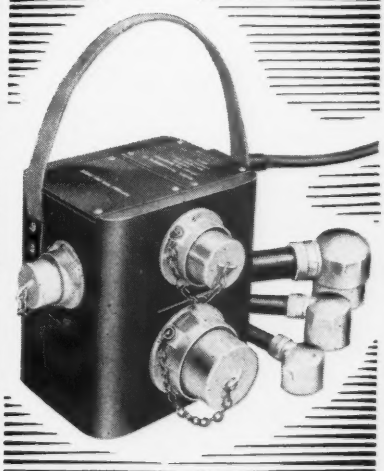

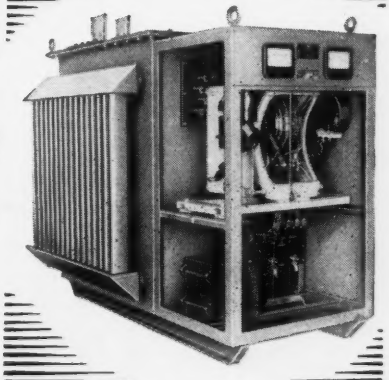

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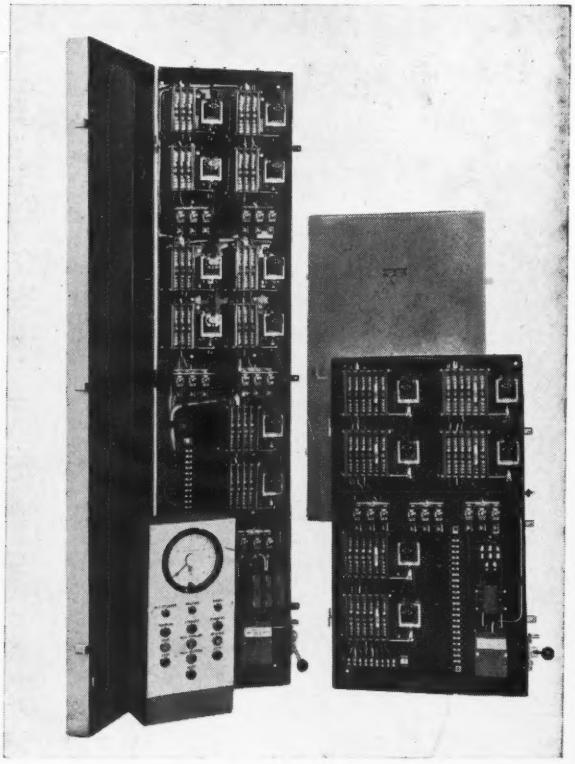

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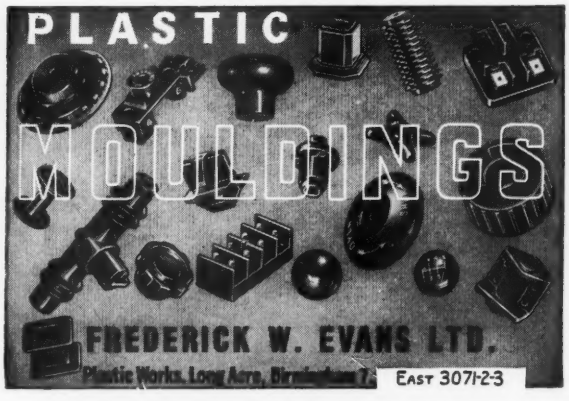

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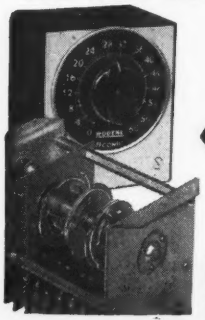

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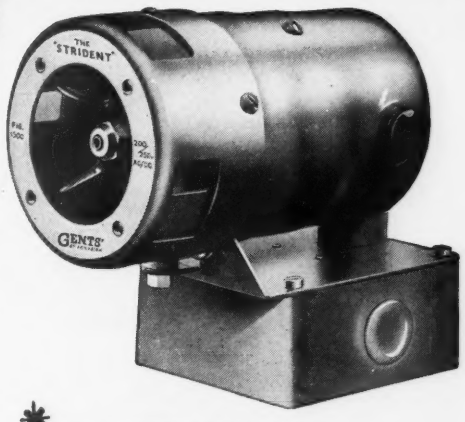
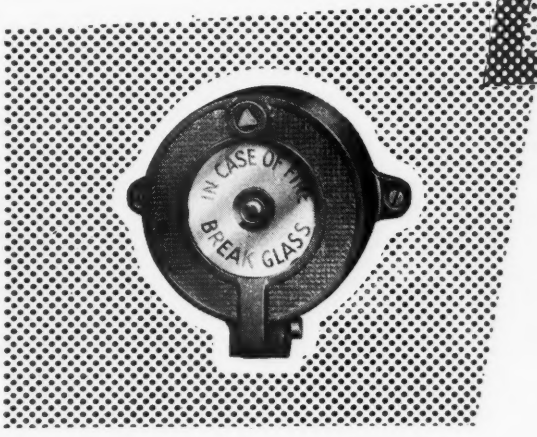


* **The 'STRIDENT' Syren**



The Fig. 1109 Contact illustrated above is especially suited for use in conjunction with the "Strident" syren. "Break the Glass" type, finished red enamel. Tapped for ¾" conduit. Three "Strident" syrens can be controlled by this contact. **Price £2 · 11 · 8**

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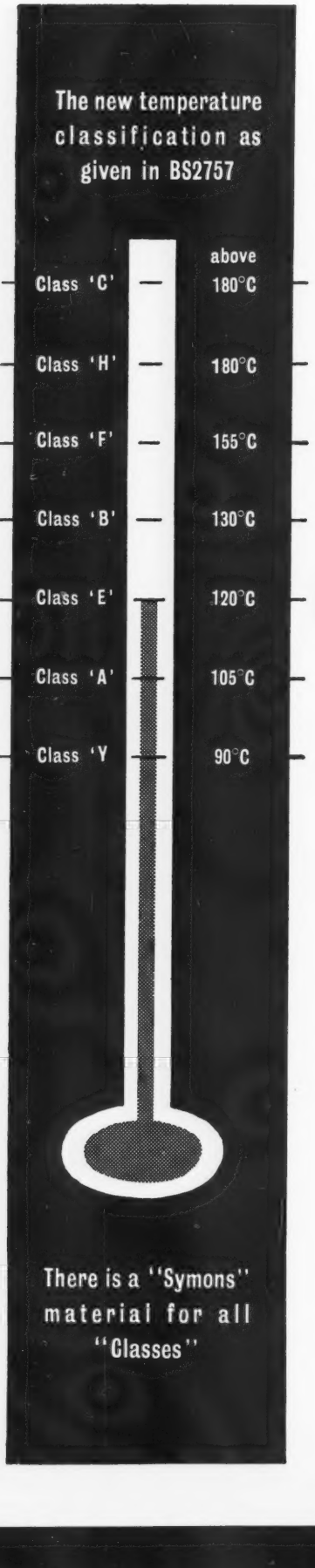
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For **440 Volts** *and* **600/660 Volts**

For use in temperate and tropical climates

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REPORT No. 1919-53 ARNHEM SHEET No.

Report of Performance of breaking capacity of low voltage cartridge fuse links

Maker:
Tested for: EMP Electric Ltd. London (England)
Rated voltage: EMP Electric Ltd. London (England)
Rated current: 440 V
Designation: 300 and 500 A
2/EJC 500 3/EJB 300

The cartridge fuse links have been subjected by N.V. to Keuring van Electrotechnische Materialen Arnhem Holland to breaking capacity tests, which have been made subject to any observations in the record, in accordance with clients instructions.

The results are shown in the Record of Performance tests and by the oscillograms sealed and attached hereto. The documents under seal forming parts of this report of performance are:

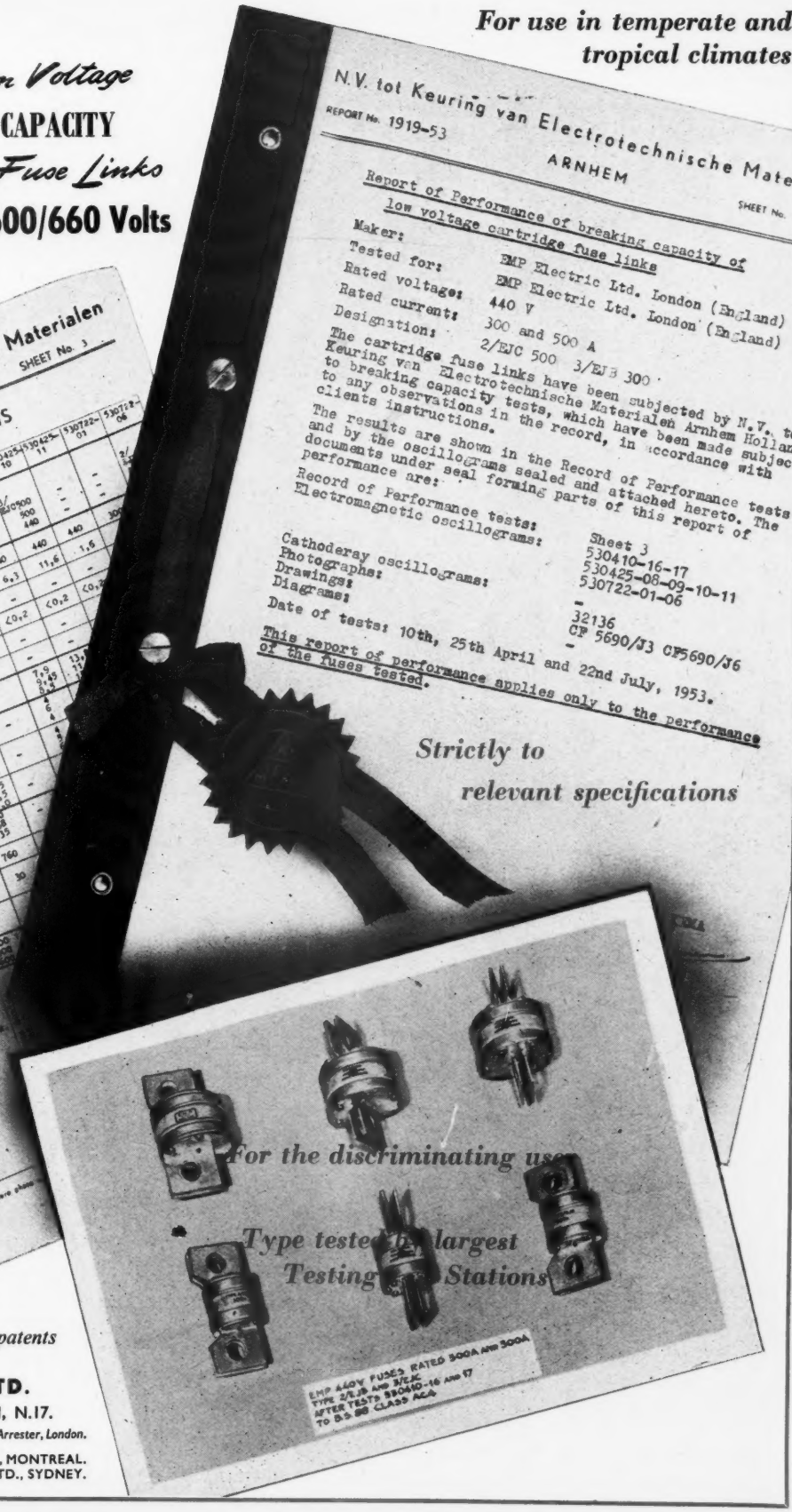
Record of Performance tests: Sheet 3
Electromagnetic oscillograms: 530410-16-17
Cathoderay oscillograms: 530425-08-09-10-11
Photographs: 530722-01-06
Drawings: -
Diagrams: 32136
Date of tests: 10th, 25th April and 22nd July, 1953. CP 5690/J3 CP5690/J6

This report of performance applies only to the performance of the fuses tested.

Strictly to relevant specifications

ing van Electrotechnische Materialen ARNHEM SHEET No. 3

SCHEDULE OF TEST RESULTS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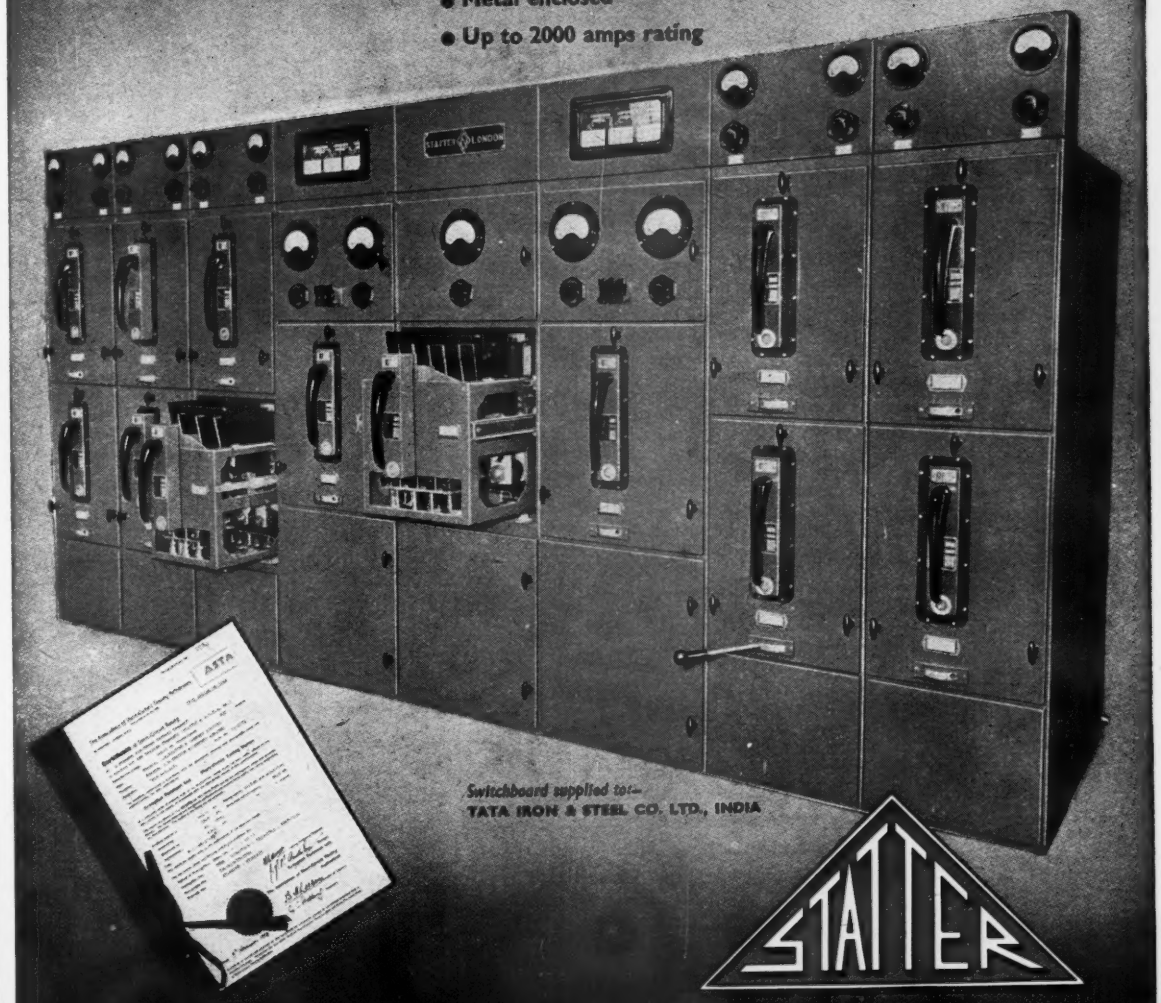

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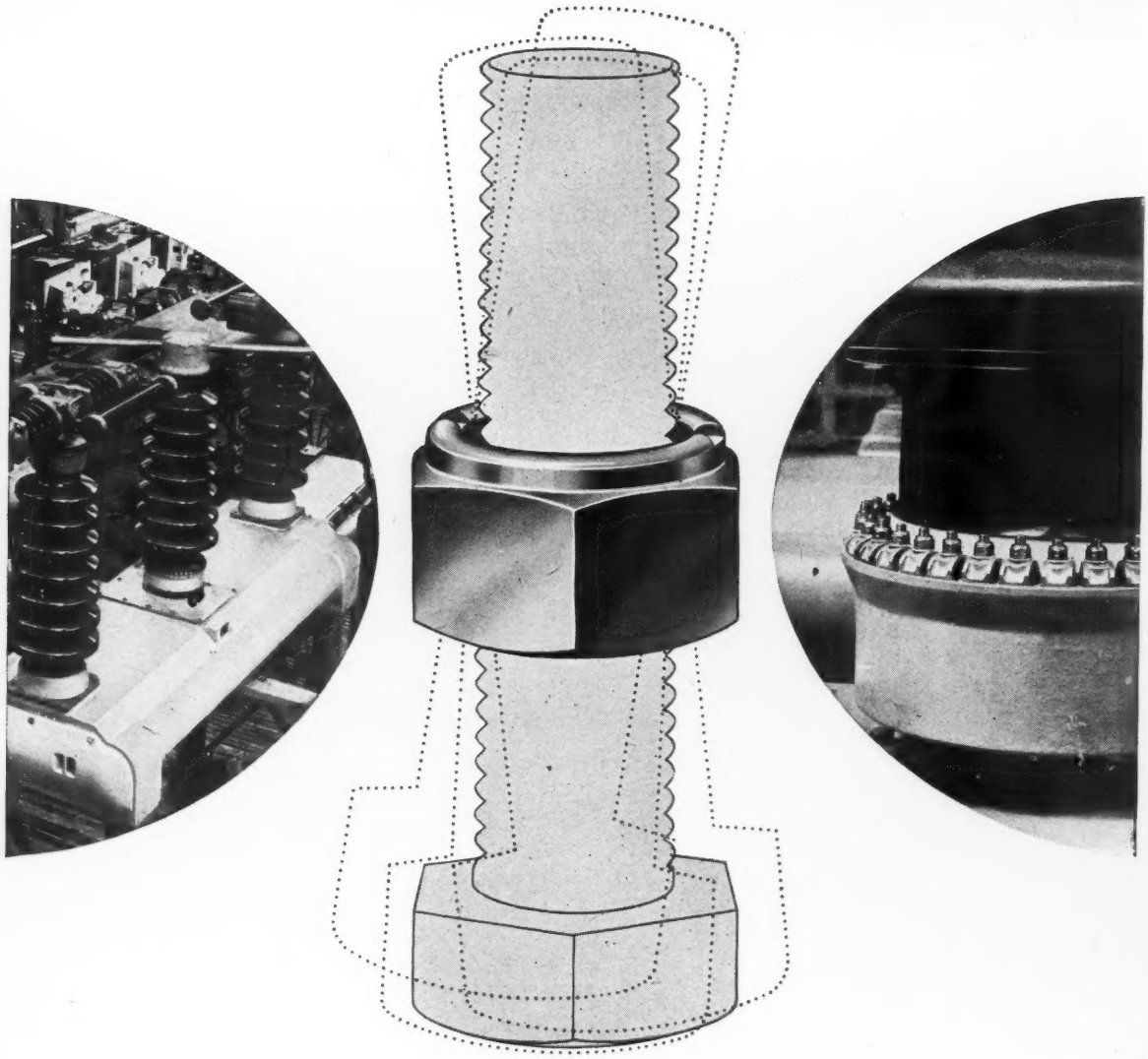

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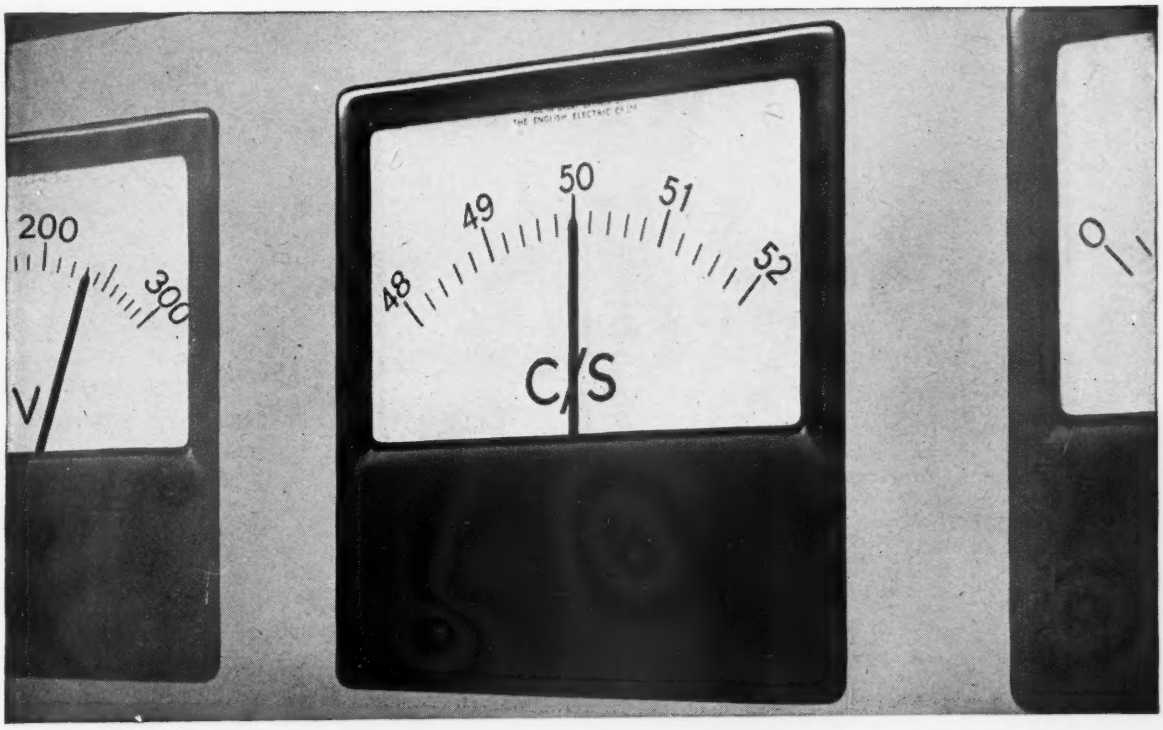

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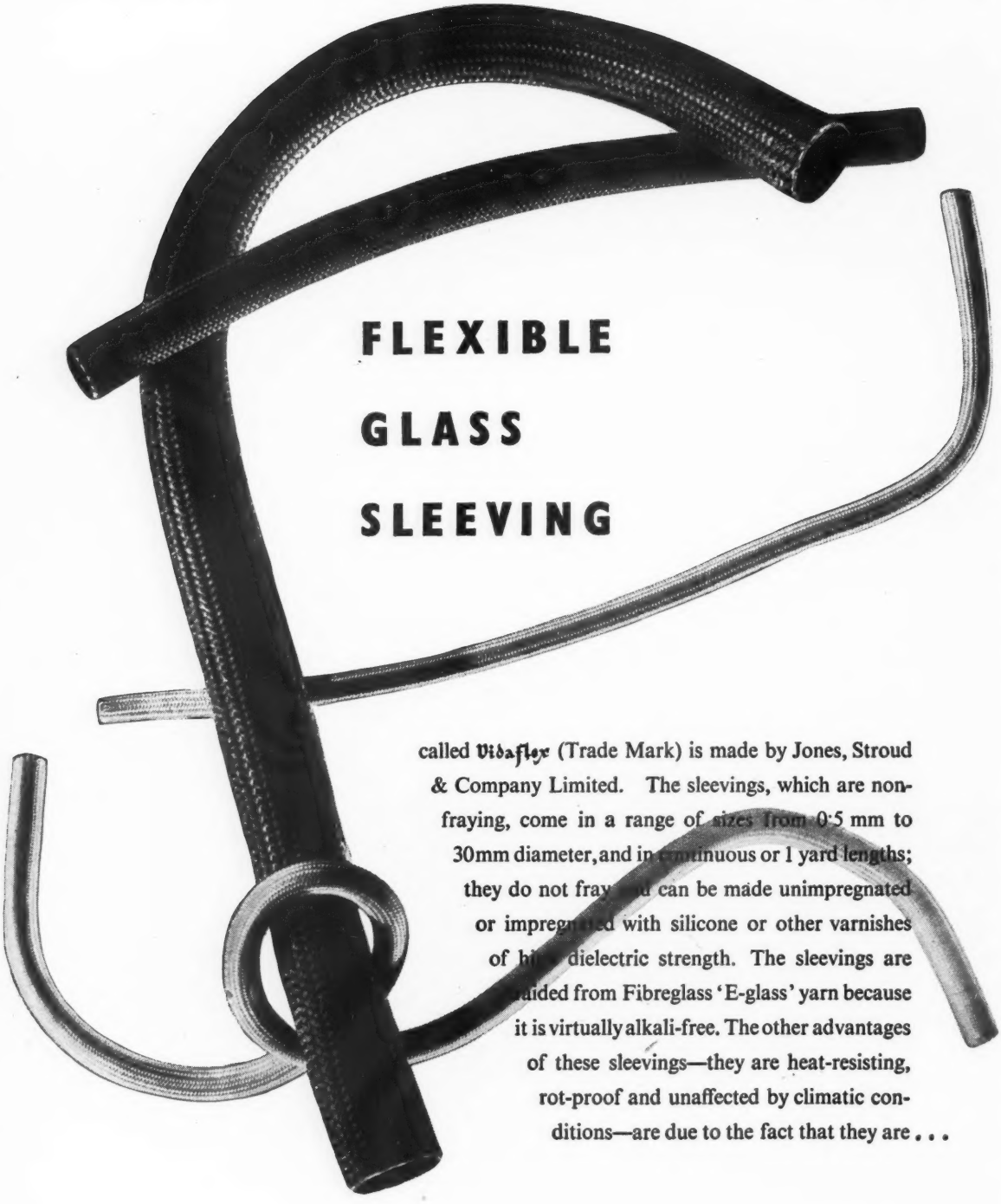

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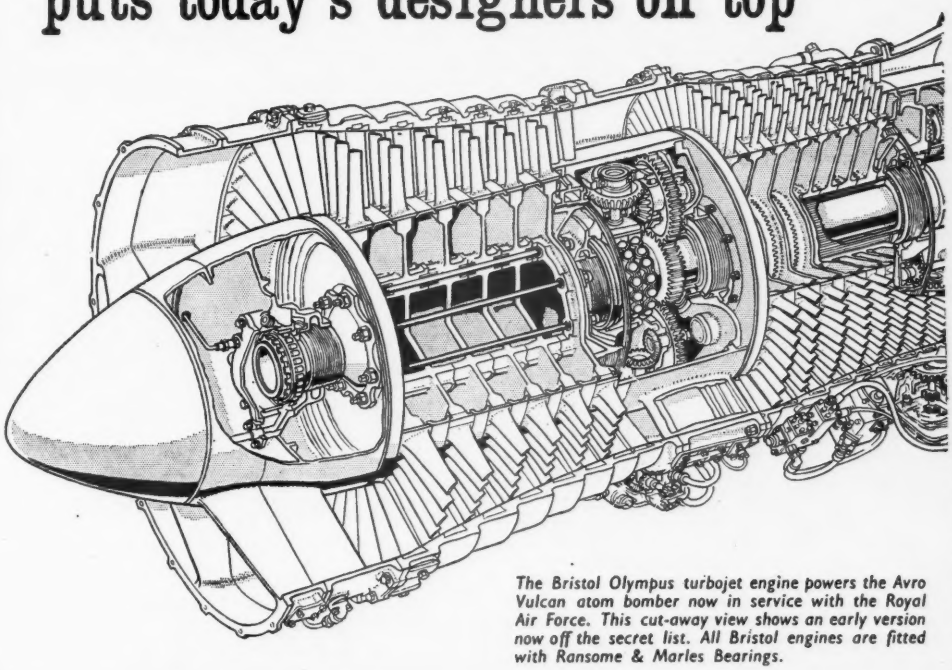

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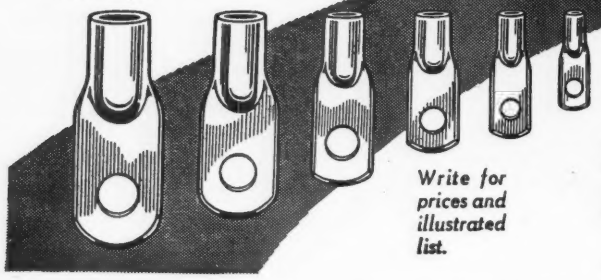

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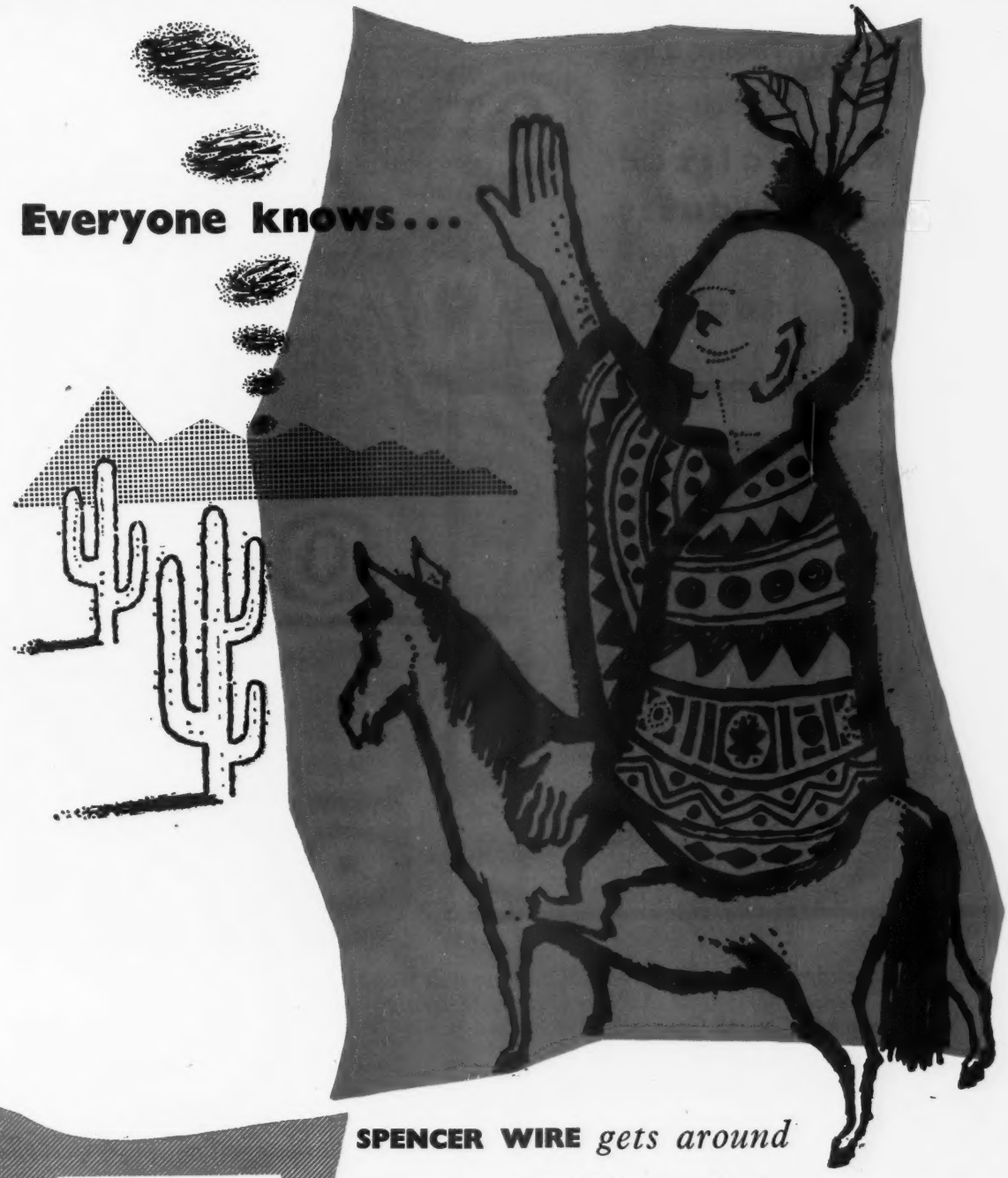

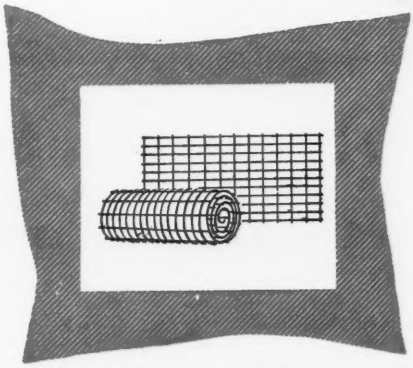

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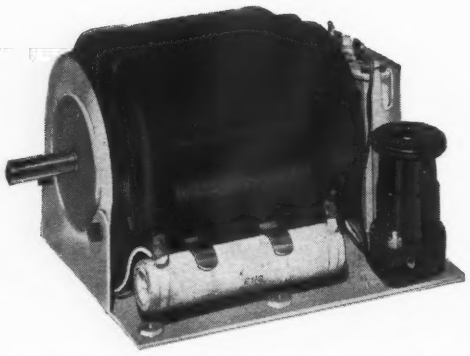

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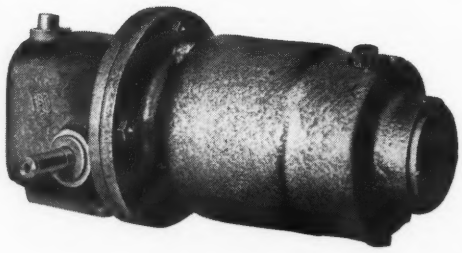

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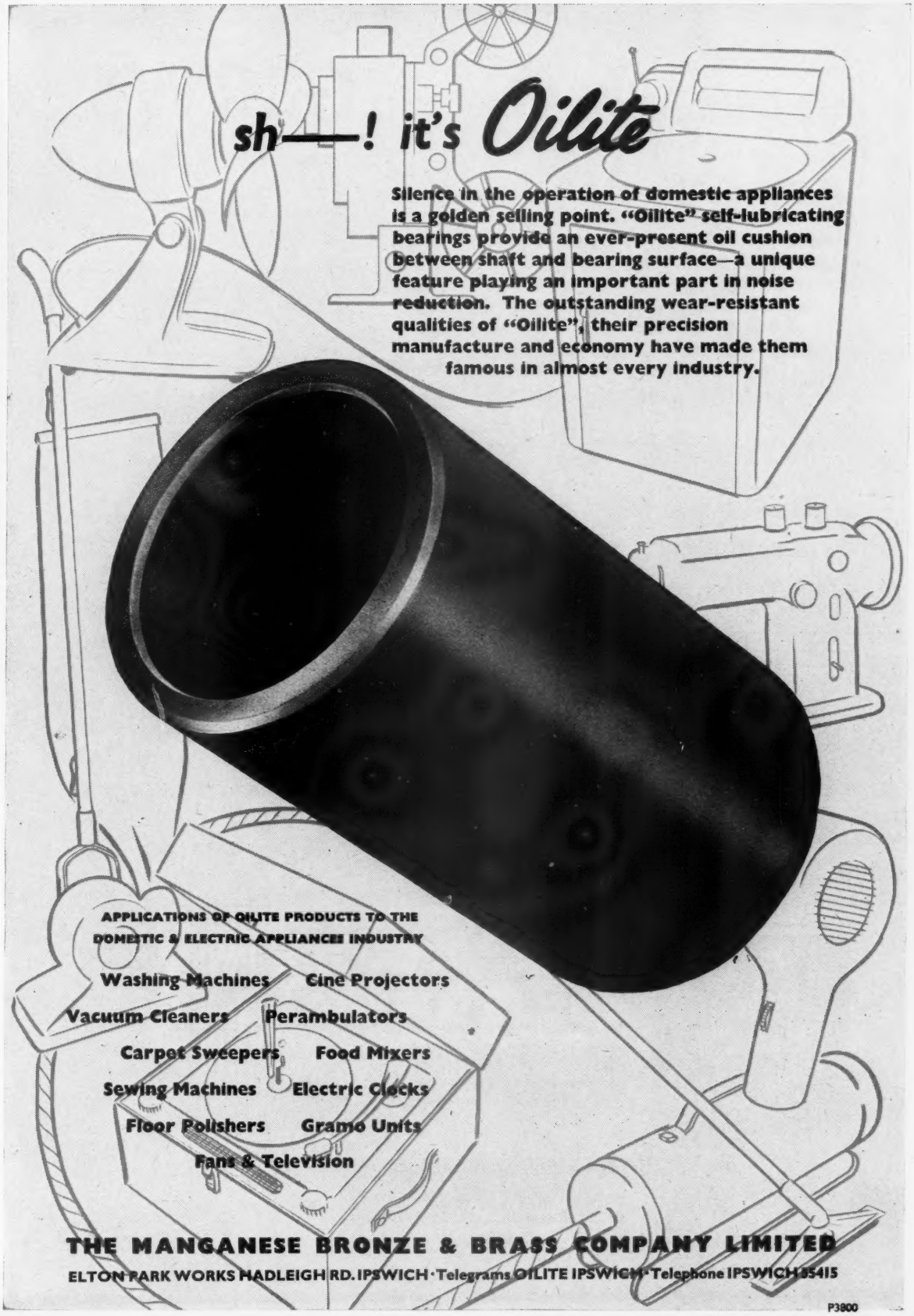

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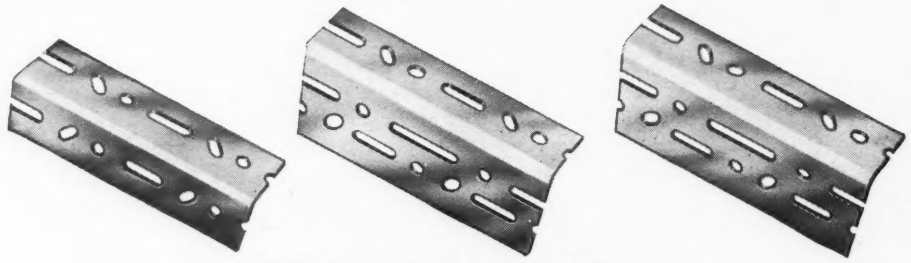

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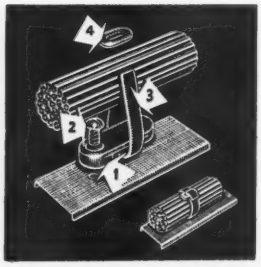

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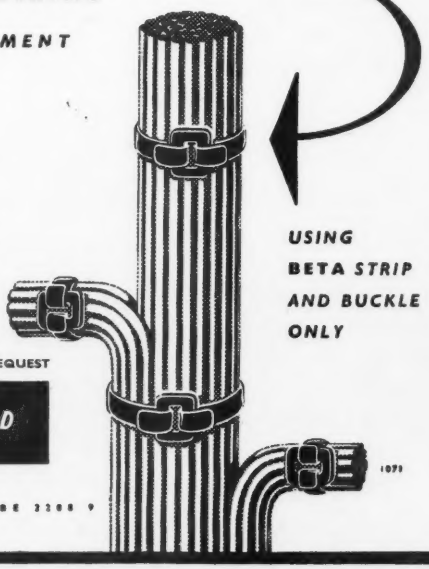

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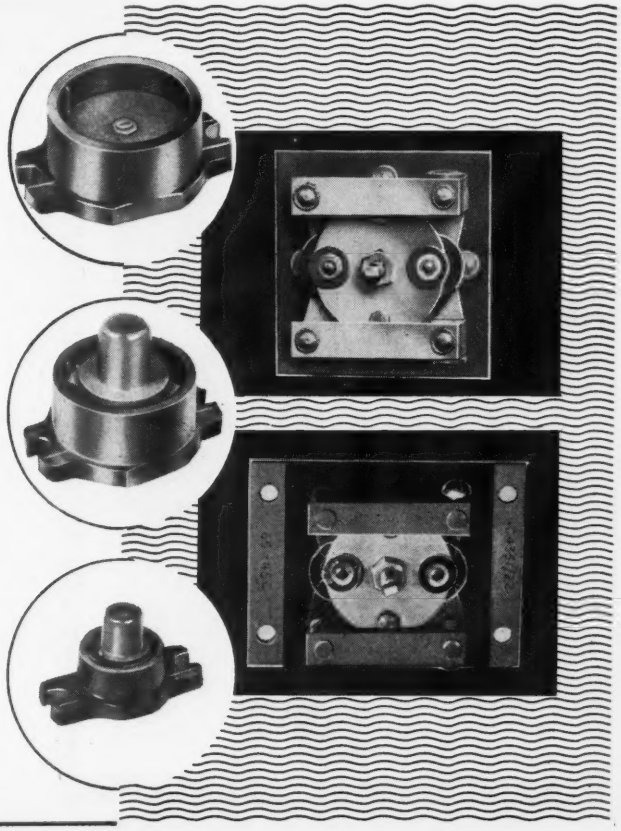

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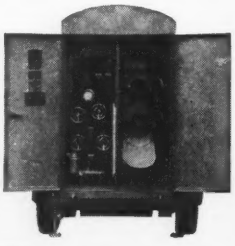

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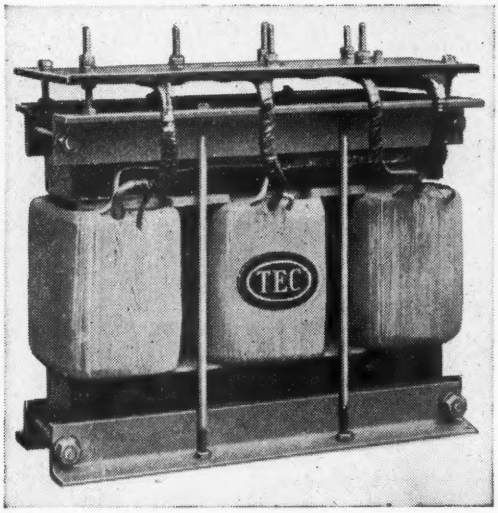

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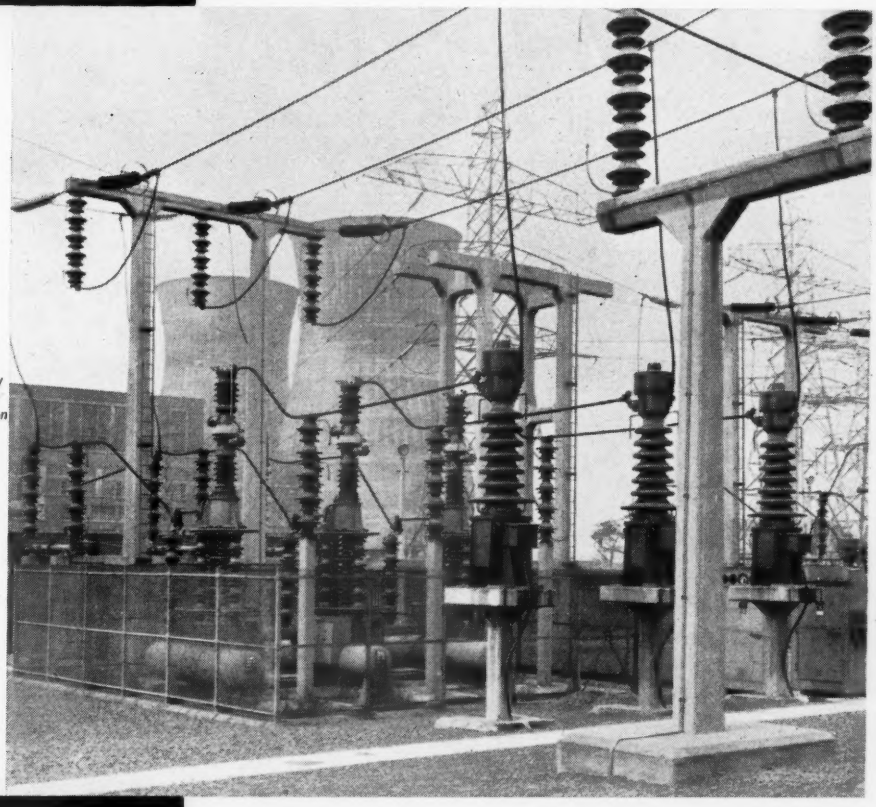
WAKEFIELD B POWER STATION



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REYROLLE SWITCHGEAR

The main 132-kV 2,500-MVA air-blast switchgear at Wakefield B Power Station together with its associated control equipment was supplied by Reyrolle who were also responsible for the 3·3-kV and 415 volt auxiliary air-break switchgear

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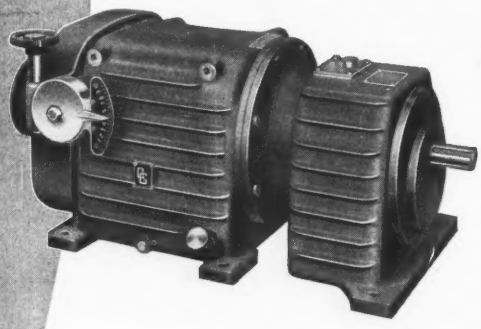

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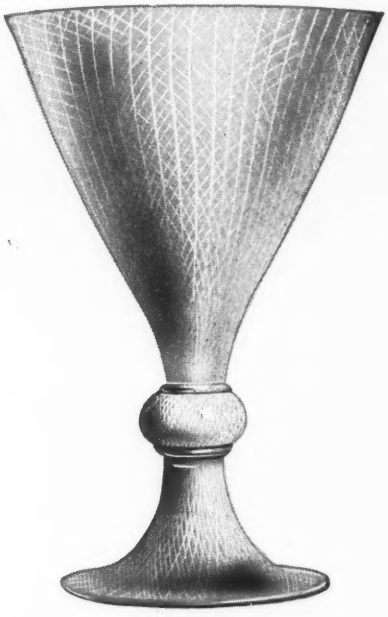

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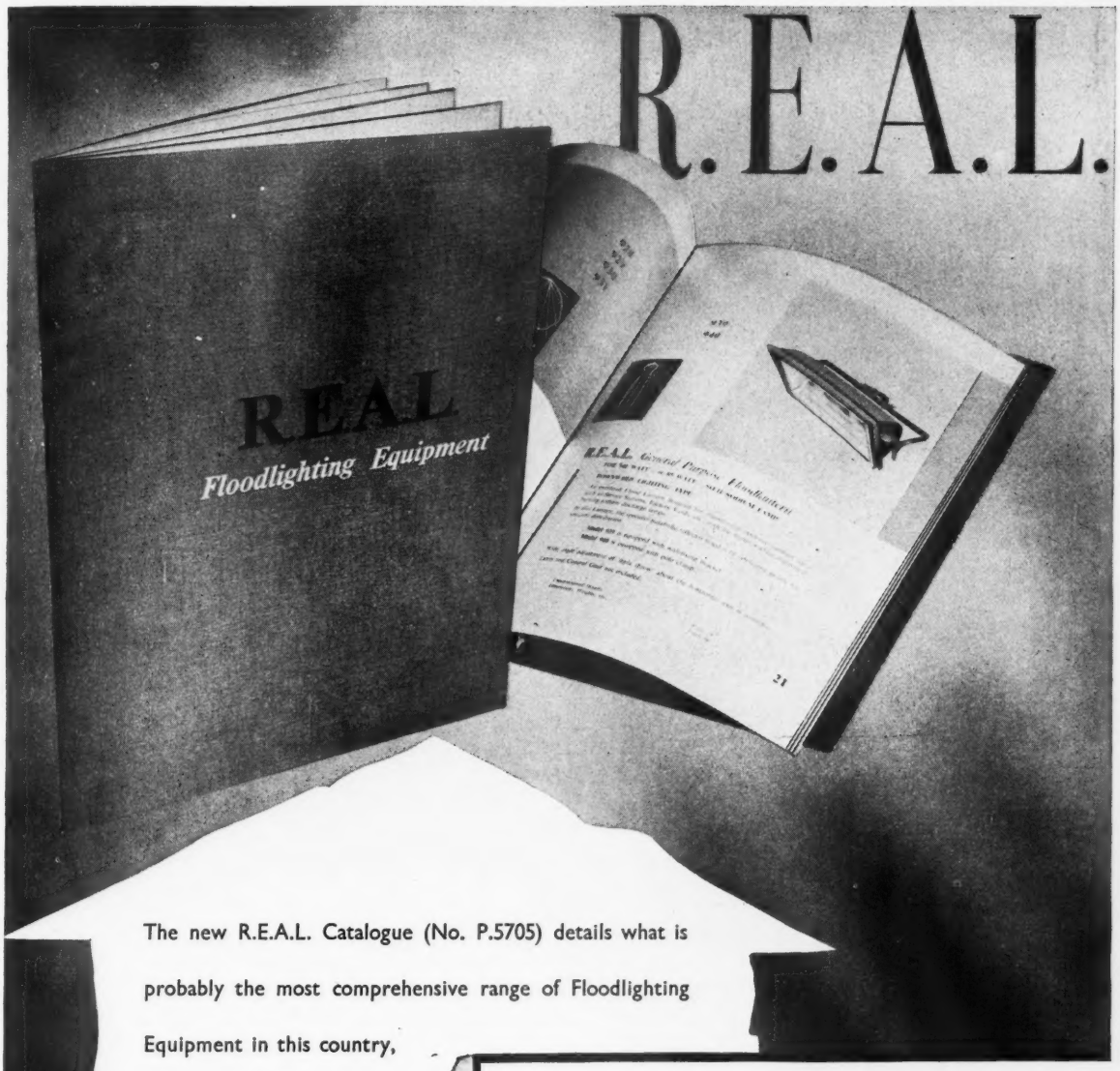

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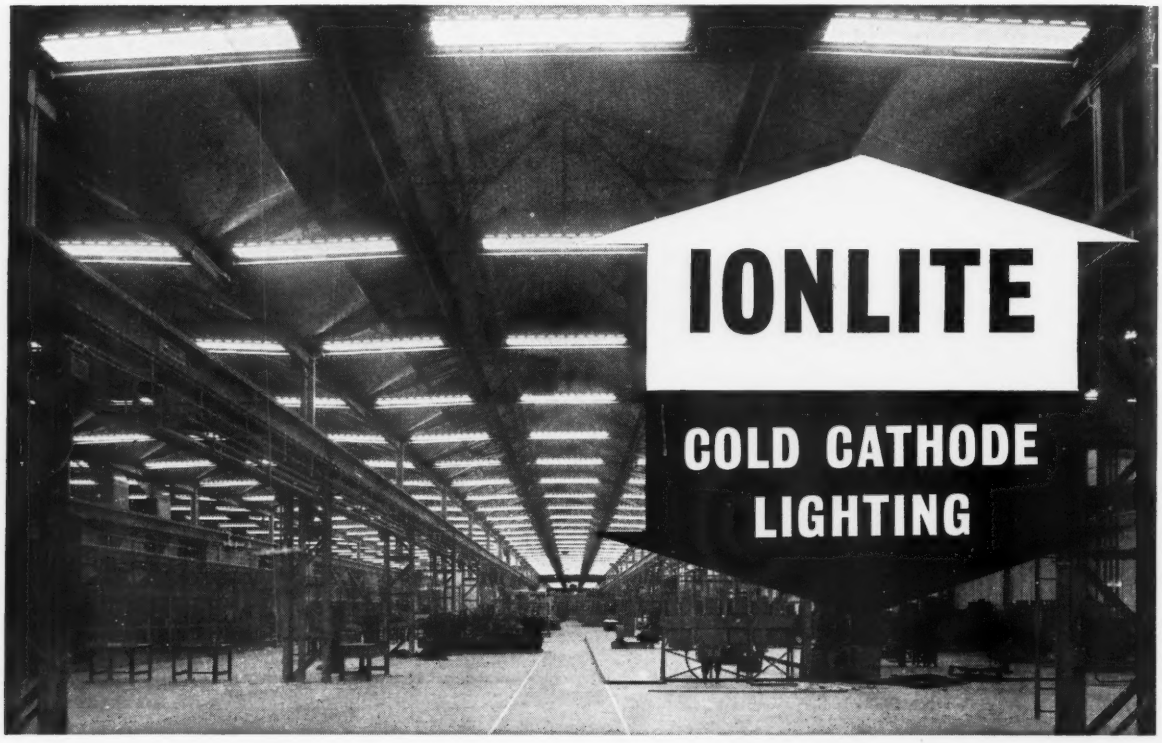

Photograph shows Otis Elevator Co. Ltd., Liverpool Factory

IONLITE LIMITED, 89 SCRUBS LANE, N.W.10. LAD. 2468 *A member of the* **FALKS** *organisation*

AP.14

All cables in ONE duct

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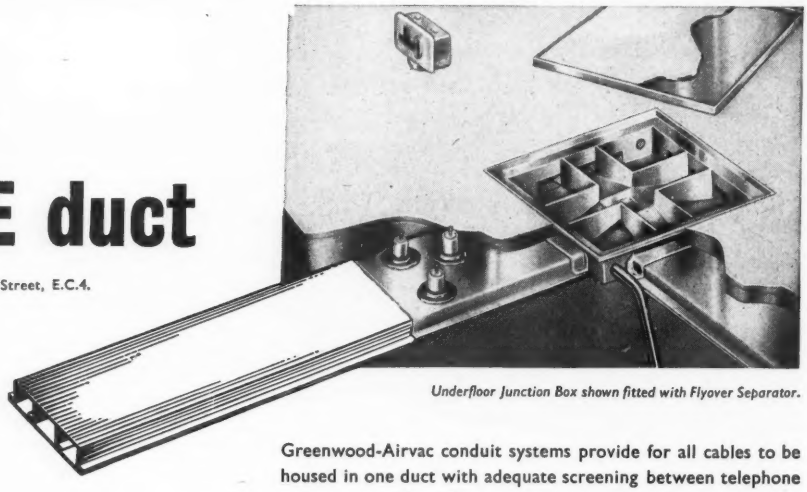
Another Greenwood-Airvac Conduit underfloor installation



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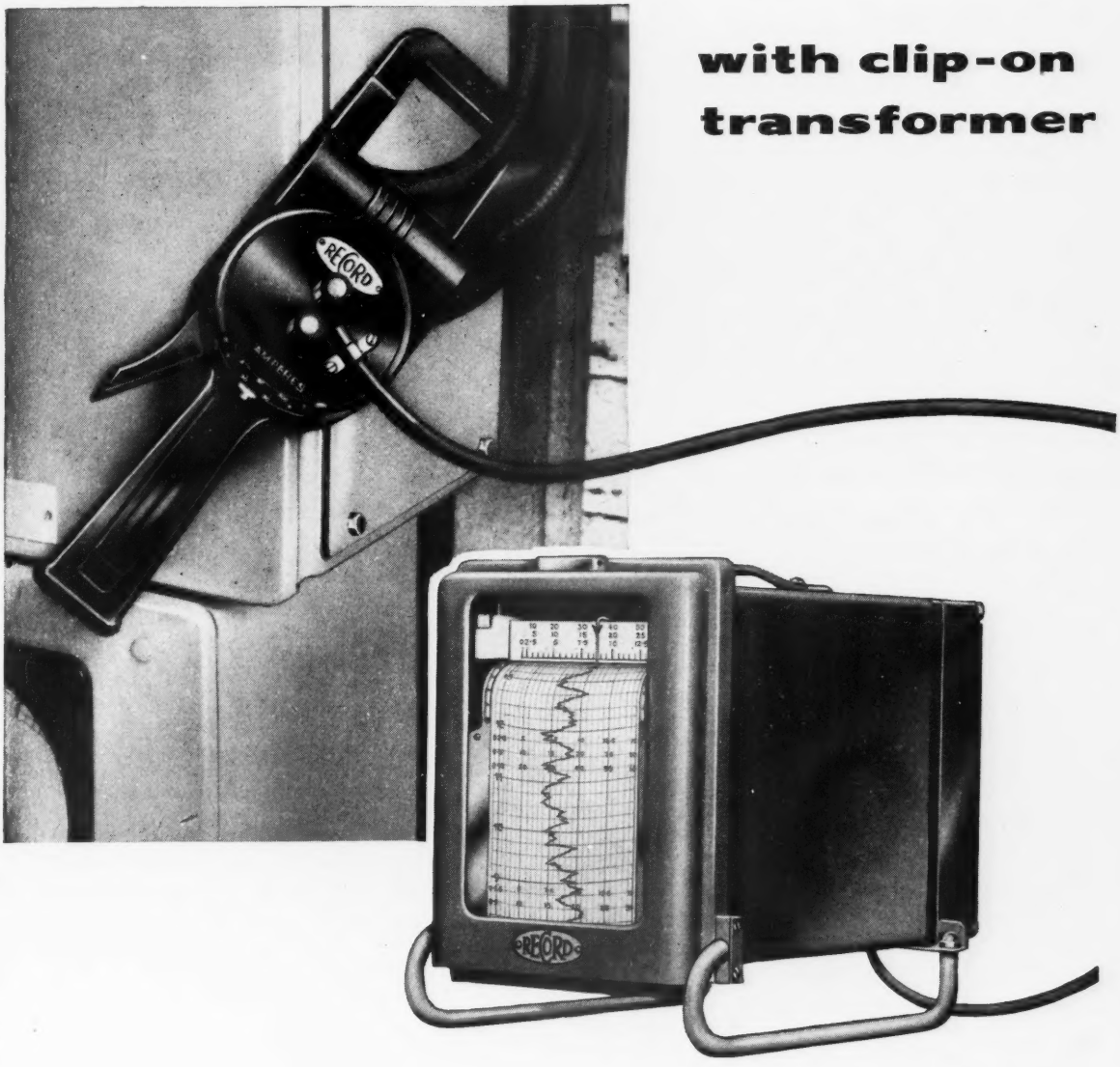
with clip-on transformer



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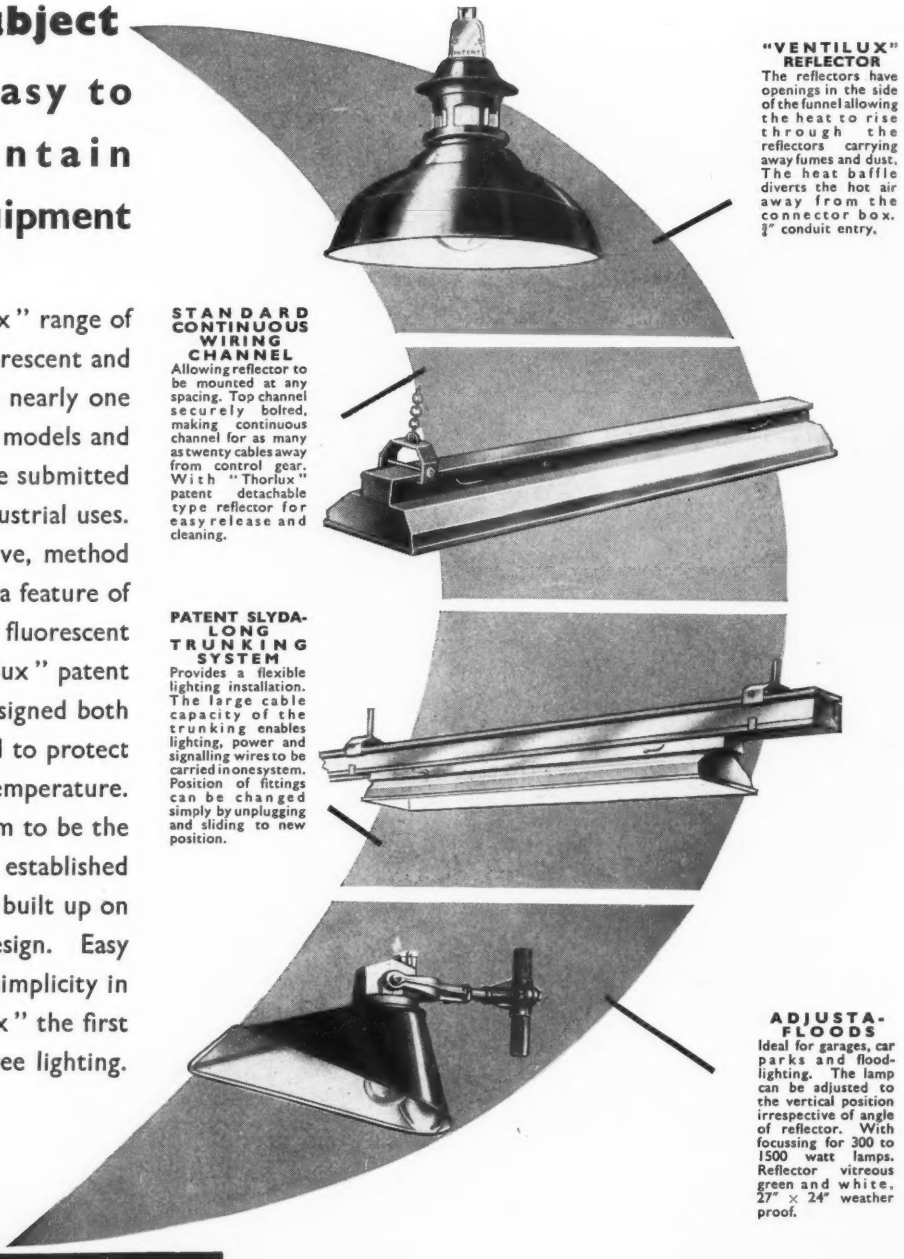

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The reflectors have openings in the side of the funnel allowing the heat to rise through the reflectors carrying away fumes and dust. The heat baffle diverts the hot air away from the connector box. ¾" conduit entry.

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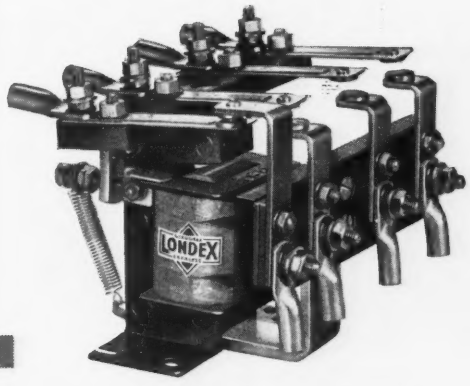

General Service Contactor Type LB
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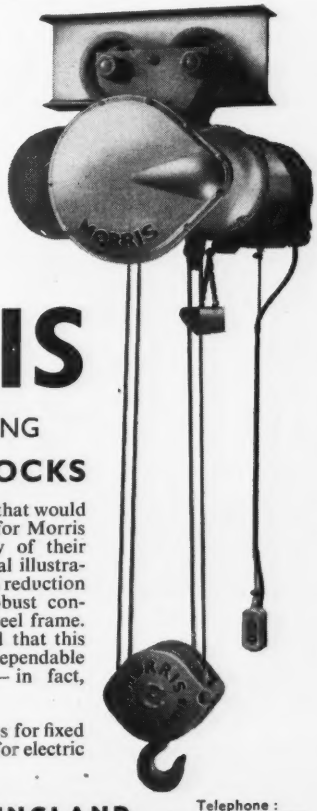

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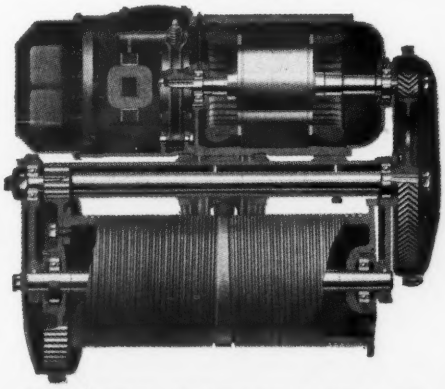

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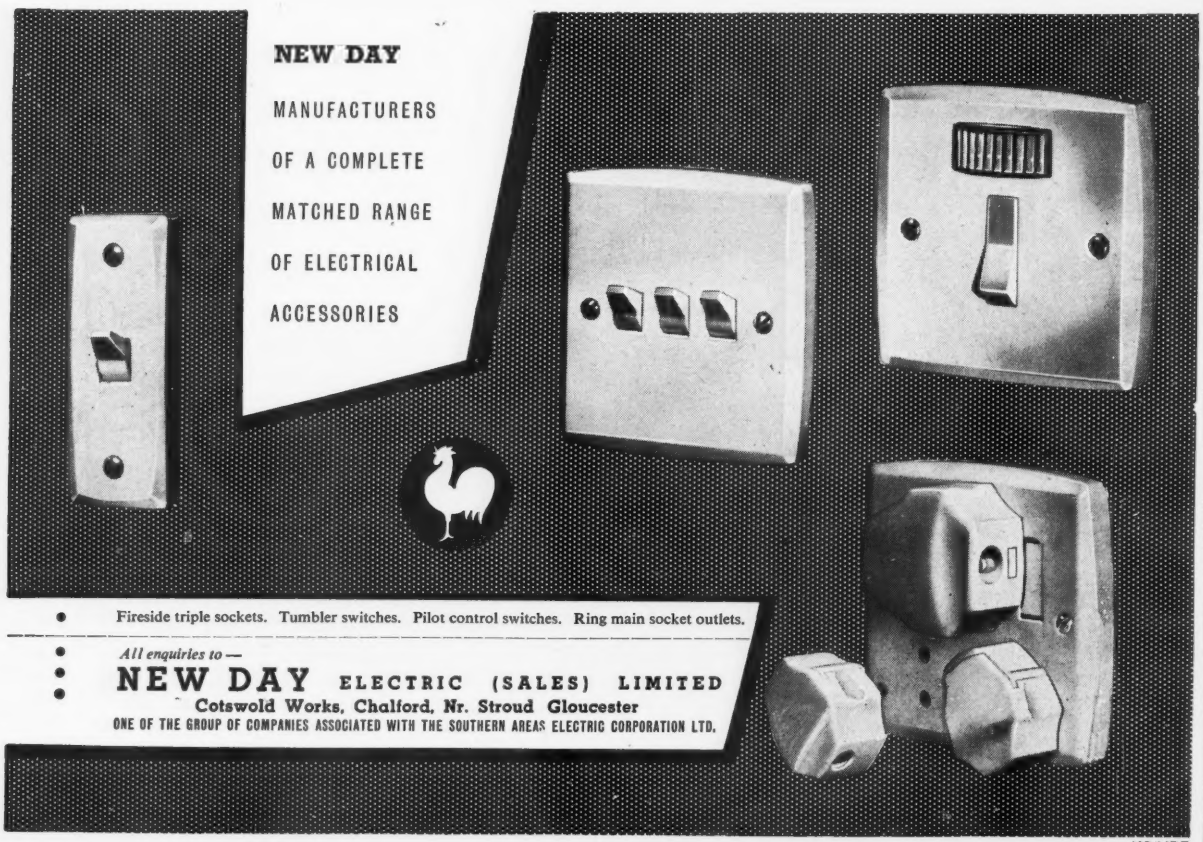

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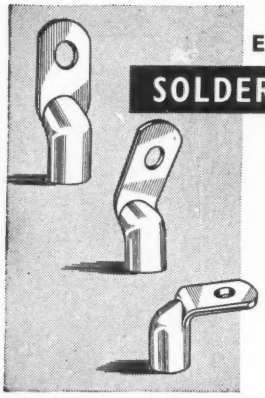

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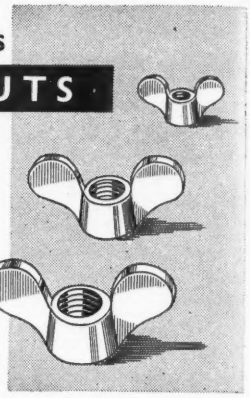

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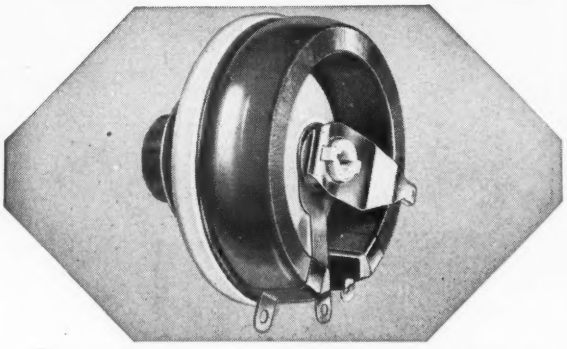

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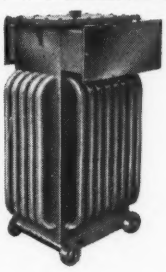

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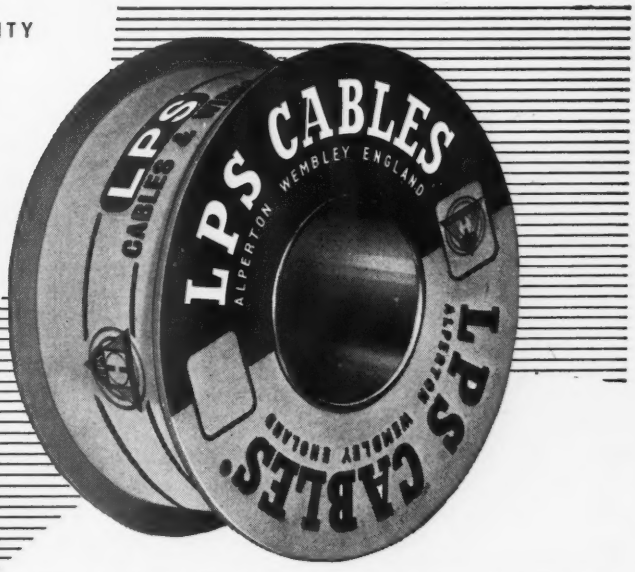

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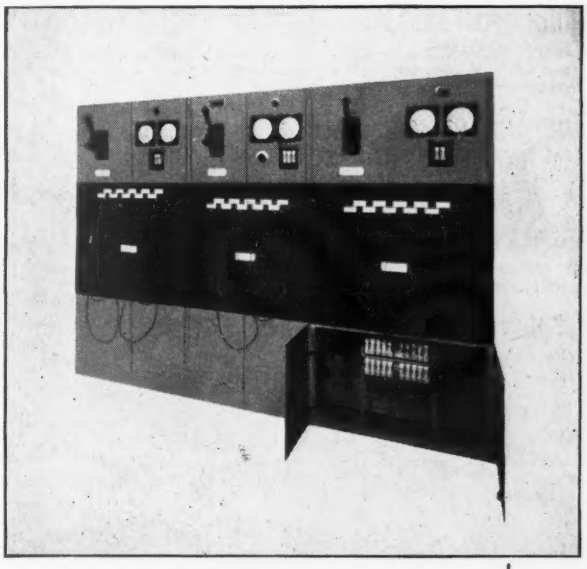

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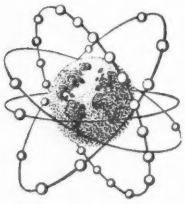

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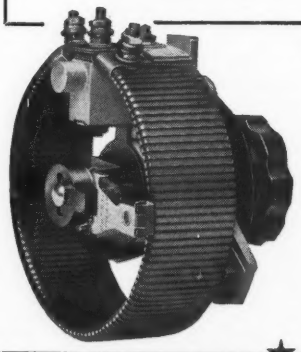

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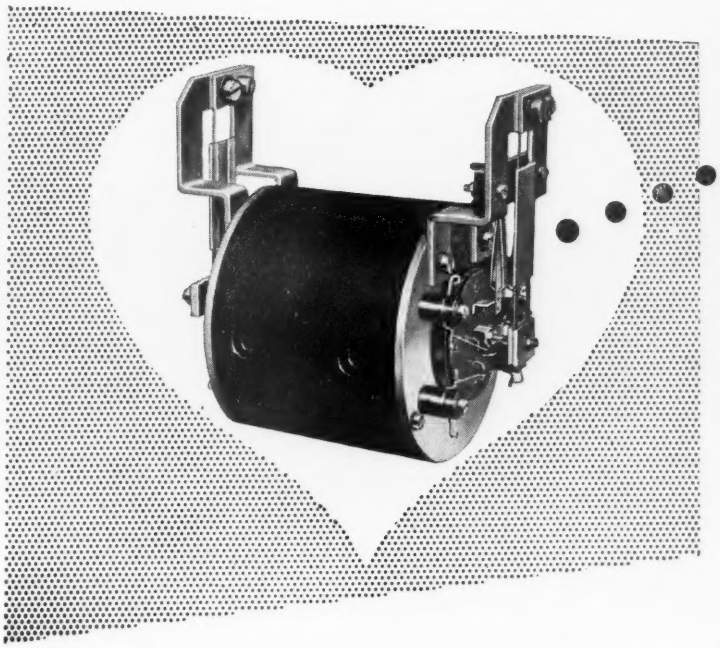

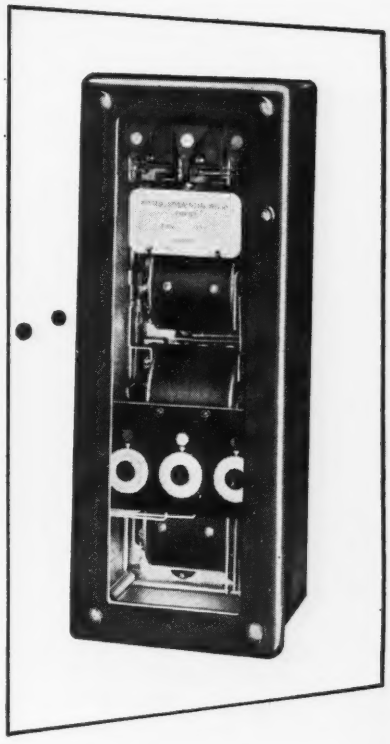

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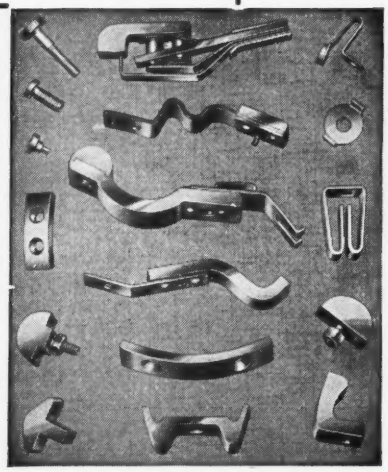

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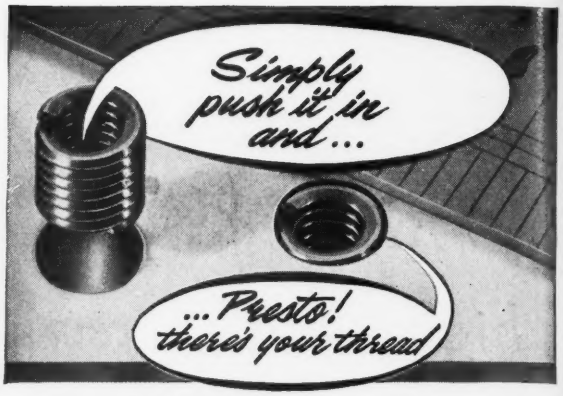

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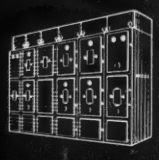

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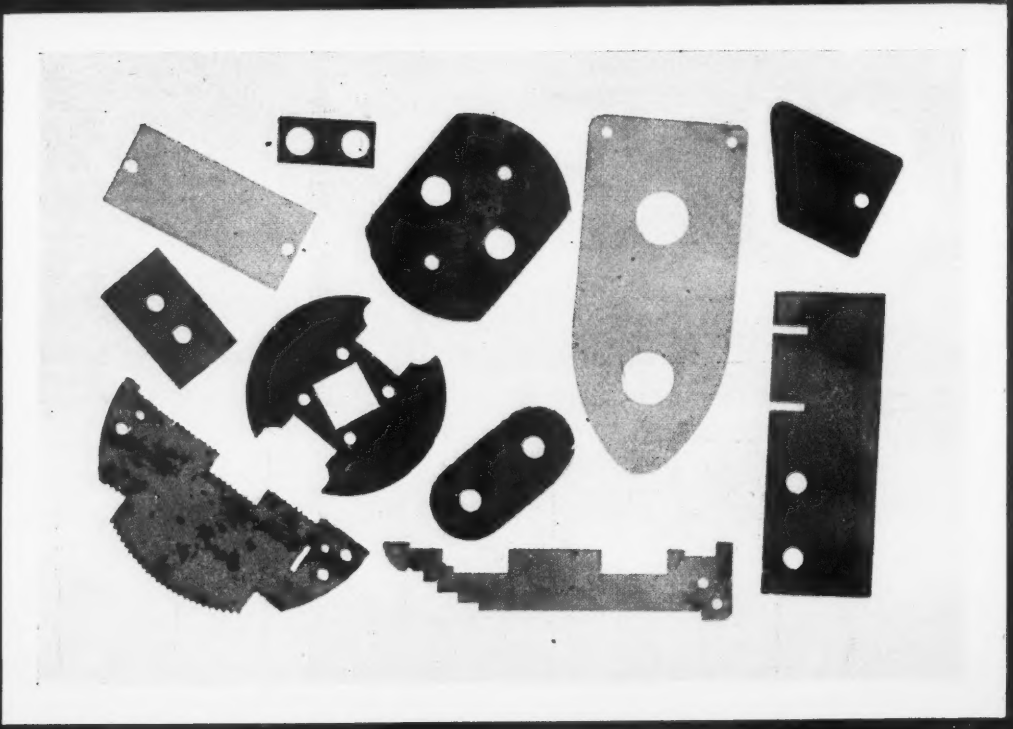

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1957

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In This Issue

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Most under-developed countries lack an adequate power supply and it has been suggested that small nuclear reactors might be the means of overcoming this deficiency. Some of the practical problems are here discussed

Semi-Conductor Rectifiers 587
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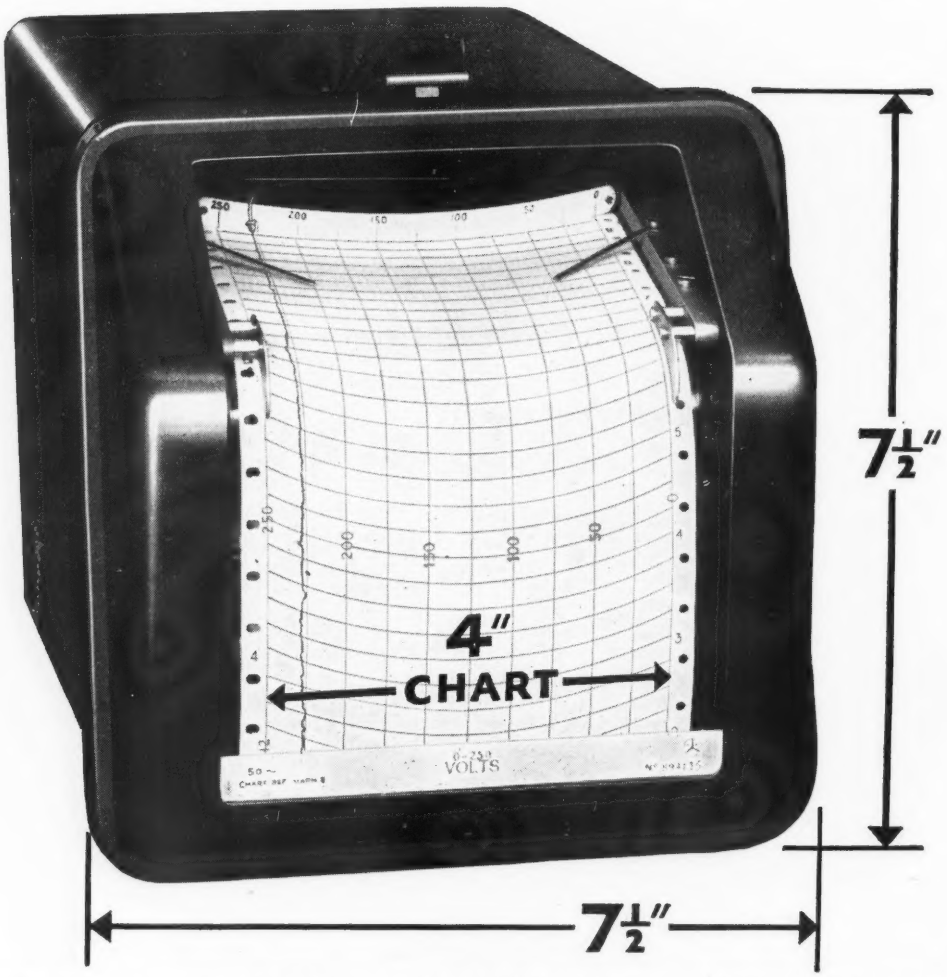

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4 October 1957 Vol. 161 No. 14 Established 1872

Small Nuclear Reactors

AMONG ways in which modern technology might appear able to promote the well-being of under-developed countries comes the use of nuclear fission. The position is somewhat vague, since the term " under-developed " covers vast differences in local conditions ranging, for example, from the presence of indigenous natural energy resources that only await engineering application to their virtual non-existence. The issue was clarified at the recent World Power Conference in relation to atomic energy (reported by us on 19th July) by Mr. J. C. Duckworth, deputy chief engineer (nuclear power), Central Electricity Authority, who, in co-ordinating present information on the subject, brought it within a practical scope for discussion by pointing out certain features that generally characterise such areas. These are the absence of an integrated electricity supply system, a small electrical demand at a poor load factor and a high rate of interest on capital investment, the proportion of which available for the purpose is in competition with claims of an advancing general industry. The last-named consideration is of especial importance in view of the high cost of reactors, the capital charges on which may form two-thirds of the cost of nuclear power.

The choice of reactor would wisely be restricted to designs of proved reliability and inherent safety which use fuel that is plentiful. The only design now known to meet these requirements in commercial service is the graphite-moderated gas-cooled type using natural uranium. The steepness of the rise in capital cost with reduction in output capacity, however, appears to render it unsuitable without fuel enrichment in the small ratings normally required in early stages of electrification. Physical size and hence presumably capital cost might be cut down by the use of other types of reactor under development for using enriched uranium. If these prove successful, there would still be the difficulty that the provision of this scarce fuel would entail continued dependence on restricted foreign sources of supply, since the heavy expenditure incurred in providing plant for processing natural uranium would no doubt be prohibitive.

While high capital expenditure implies an economic necessity of running plant at a high annual load factor, there is also a need to take into account possible adverse effects on reactor performance of variable electrical loading. These two considerations indicate that nuclear power stations of any size should be interconnected with others of a more conventional kind. On the present showing Mr. Duckworth's conclusion seems inescapable that nuclear power is unlikely to be generally applicable in under-developed regions unless the cost of " fossil " fuel is very high or water power is not available.

NOW—AND THE FUTURE

Commenting upon the Central Electricity Authority's report, the *Manchester Guardian* said last week that since the effect of the present financial restrictions may possibly be to reduce the country's demand for electricity substantially, it is only natural that the C.E.A.'s plans for the future should be drawn with caution. This not only misjudges the C.E.A. but also ignores past experience. Those outside the industry, although otherwise well-informed, do not seem to realise that electricity supply expenditure is not of the nature which gives immediate results. What is done to-day has a profound influence on the future. While it may seem proper to cut down this expenditure as a contribution to the solution of to-day's problems, what really has to be regarded is the possible effect in four or five years' time.

The electricity supply industry has only just emerged from the near-disastrous situation in which it was placed by wartime economies. We do not want to see that situation re-created. The demand for electricity will continue to expand and the industry must be ready to meet it.

WHAT IS HAPPENING ?

The leading article in the September *Electrical Power Engineer* (the journal of the Electrical Power Engineers' Association) complains about the limitations of the National Joint Advisory Council. While (it implies) safety, health, welfare and education are given a great deal of attention what is needed is greater discussion of policy matters, which should not be regarded as purely a management preserve.

We realise that there may be justifiable reluctance on the part of the management to invite discussion on some matters, but the one with which the E.P.E.A. is mainly concerned—the future of its members—might legitimately be tabled. The changes in electricity supply organisation now being made will affect quite a number of people and it is not only the E.P.E.A. which is anxious to know what is happening. Less than three months remain before the changes take effect but, apart from the announcement of a few senior appointments, nothing has been said about the new structure. It is to be hoped that there will not be much further delay.

CREDIT AND COMPENSATION

In the recent past we have contended that British manufacturers must be allowed to recoup for the country some of the vast expenditure incurred in atomic research and development. *The Times* last week published an article by Viscount Chandos in which he put the case against this country's becoming a "full member of Euratom," the consortium of six European countries which have agreed to pool information on the peaceful uses of nuclear power.

Lord Chandos says that we already have a proved system of generating power from natural uranium. If the industrial nations of Europe acquired full information about the construction and operation of our nuclear power stations they would not order plant from us but produce it themselves. Therefore we should seize the immediate opportunities of selling what we can, particularly special equipment such as "instrumentation" and for the rest make normal commercial arrangements for the sale or exchange of "know-how."

The world is giving us credit for what we have achieved but we also have earned some material compensation.

NUCLEAR POWER

In much the same way that it has always been necessary for the generation engineer to know something about the chemistry of the fuel of his time, in the main coal, so will it become increasingly necessary for the same class of electrical engineer to know something about the chemistry of nuclear energy fuel, or may be later on, fuels. In this respect we think the main value of Mr. Jay's article under the above title in this issue lies in what he tells us about the make-up of the new fuel in its various stages from its natural state to the spent product which may well contain an even more valuable fuel.

As the author points out, the whole question of utilisation and fuel cycles is complicated, depending as it does on economic as well as technical considerations. A few years ago it was considered that something like 100 per cent utilisation, and consequently breeding, would be necessary before the construction of nuclear power stations was embarked upon, but the discovery since of much larger quantities of exploitable uranium ore has modified this view.

SEMI-CONDUCTOR RECTIFIERS

To those of us who have lived for some time in a world of evolutionary developments, the revolutionary changes of technique which have been taking place during the past few years have been, to say the least, a drastic experience. It is probably true to say that in no case has the impact of new revolutionary techniques been greater than in the case of semi-conductors—germanium, silicon, and so on.

We think this is brought out very forcibly by Mr. D. Ashby in his article on the subject in this issue when he emphasises the leading properties of semi-conductors. Their resistance varies according to the direction in which it is measured and this asymmetry allows them to be used as rectifiers. The resistance changes with temperature in the opposite manner to conductors such as copper and other metals, in that a rise in temperature results in a fall in the resistance of the rectifier. This negative temperature coefficient may lead to thermal instability and greatly influences the voltage rating of the rectifier.

DOMESTIC ELECTRICITY

Next week's *Electrical Review* will be the annual Special Domestic Issue. It will contain, as usual, illustrated surveys of heating, water-heating, cooking and laundry appliances and other electrical equipment used in the home. There will also be specially written articles on various aspects of domestic electrification

Semi-Conductor Rectifiers

The Future of Silicon, Germanium, Selenium and Copper Oxide Rectifiers in the Electrical Industry

By D. ASHBY, A.C.G.I., B.Sc.(Eng.), D.I.C., M.I.E.E., A.M.I.Mech.E.*

WHEN the copper oxide rectifier was developed in this country after its introduction in 1926, the reliability claimed by the manufacturers was soon confirmed and rapid progress was made in applying this new power conversion method to battery charging, electroplating, small motor drives and electrostatic precipitation. The selenium rectifier entered the market about 1936, when its advantages of reduced bulk and higher operating temperature showed considerable advantage over copper oxide, and after 1939 engineers accepted selenium as superior to copper oxide as a power rectifier, leaving a few specialised markets in the fields of telecommunication and instrumentation to copper oxide.

Successive improvements in the manufacturing techniques and developments in the application of the rectifier have gradually widened the field for selenium as against conversion methods employing the motor-generator or mercury-arc rectifiers. While the engineer has had only one metal rectifier to consider, his choice in the immediate future will be complicated by the arrival of two new rectifiers, employing germanium and silicon, which offer great advantages over selenium, for which, however, a large demand is expected to continue as long as it proves the most economical rectifier for many purposes. The germanium and silicon rectifiers will be used mainly in extending the range well into the field now supplied by the mercury-arc rectifier and motor-generator. The purpose of this article is to investigate the relative characteristics and economies of the four types of rectifier and examine their likely fields of use so that the engineer can better understand which is likely to be best suited to his problem and so avoid waste of time and effort in considering others.

The ultimate choice will depend largely on economics, and this article is incomplete in that the economics cannot yet be accurately assessed as there is insufficient full-scale production experience on which costs can be based. Prices for germanium and silicon are at present only nominal, and some conclusions are drawn indicating the expected fields of application of each of these rectifiers which will be confirmed during the next year or two.

* Westinghouse Brake & Signal Co., Ltd.

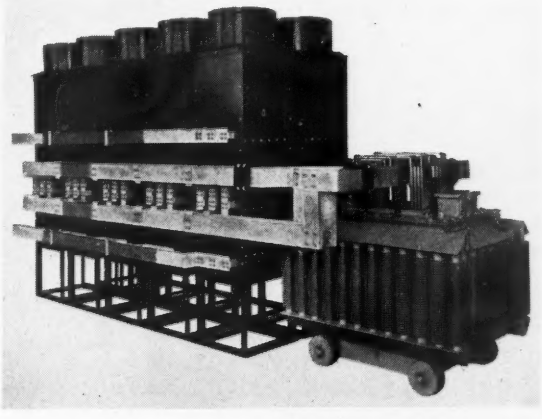


Fig. 1.—A 12,000 A air-blast-cooled copper oxide plating rectifier built in 1933

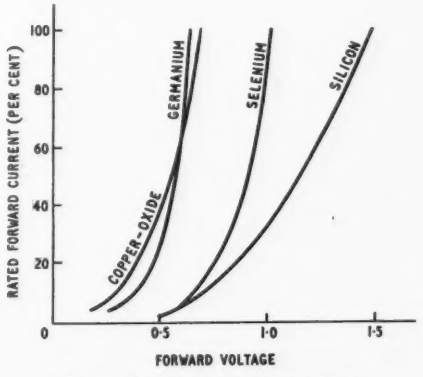


Fig. 2.—Typical forward characteristics

General Properties of Semi-Conductors

A study of semi-conductors employed as power rectifiers must begin with an examination of the voltage-current characteristics which decide the number of series elements and parallel paths of rectifier for any particular project and so determine the size, efficiency, voltage regulation and overload capacity of the rectifier equipment and, in conjunction with a knowledge of the ambient temperature, indicate the most suitable system for cooling the rectifier.

Semi-conductors exhibit three important features. Their resistance varies according to the direction in which it is measured. This asymmetry allows of these devices being used as rectifiers. The resistance changes with temperature in the opposite manner to the conductors such as copper and other metals, in that a rise in temperature results in a fall in the resistance of the rectifier, and this negative temperature coefficient may lead to thermal instability and greatly influence the voltage rating of the rectifier. Finally, the shape of the voltage-current characteristics is non-linear which affects voltage regulation and offers commercial applications where the variable resistance of the rectifier is employed.

Voltage-Current Characteristics

It is customary to express the resistance of a rectifier by means of the voltage-current characteristics in which the current is plotted against the voltage drop through a single rectifier element. The forward characteristics of copper oxide, selenium, germanium and silicon rectifiers are shown in Figs. 2 and 3 which allows of their direct comparison.

Let us first consider the conducting direction as represented by the forward characteristic, which follows a similar pattern for all four rectifiers in that a certain

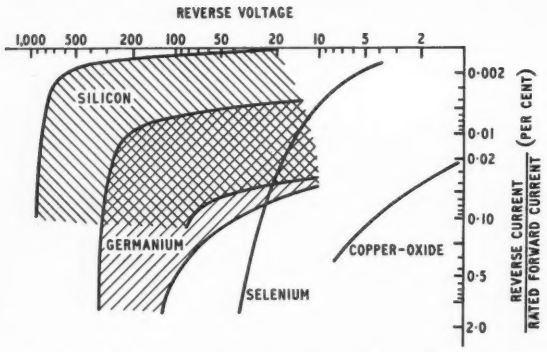


Fig. 3.—Typical reverse characteristics (note logarithmic scales)

voltage must be overcome before any appreciable current flows. Thereafter the current increases to a remarkable extent with a small increase in applied voltage. The vertical scale of current is calibrated as a percentage of the full rated current though when considering any particular rectifier calibration in current density is more informative. There is a fundamental difference between the two older rectifiers, copper oxide and selenium, which operate at a low current density, around 100 mA/sq cm of rectifier area, and the newcomers, germanium and silicon, which can be rated at 100 A/sq cm of rectifier, or in the case of silicon, much higher. The use of a common scale based on current rating does allow of a direct comparison between the four types of rectifier and relates accurately to the performance of rectifier for any particular project. It will be seen that the copper oxide rectifier has the lowest forward drop, closely followed by germanium, while the forward resistance of the selenium rectifier is considerably higher, and that of the silicon rectifier higher still.

Reverse Characteristics

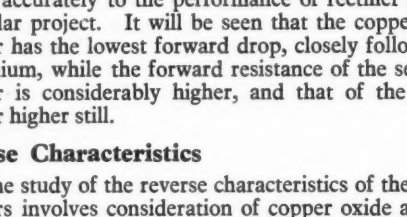
As the study of the reverse characteristics of these four rectifiers involves consideration of copper oxide at a few volts and of silicon at a few hundred volts, a linear scale of voltage imposes restrictions which can be avoided if a logarithmic scale is used. The scale of reverse current which results from the application of the reverse voltage is shown as a percentage of the forward current against which the comparison is made, thereby allowing of a direct comparison.

The characteristics shown in Fig. 3 are typical of the four types of rectifier, indicating a low working voltage for copper oxide, a higher operating voltage for selenium, while germanium and silicon are considerably higher. The characteristics of copper oxide and selenium are expressed by a single line, but germanium and silicon are shown as a broad band. In the manufacture of copper oxide and selenium rectifiers a minimum standard of performance is customary. Those which fail to meet the standard are rejected and those above the standard are not found to be substantially better. The germanium and silicon rectifiers exhibit a far wider range of characteristics. If a mean value were acceptable many would be far superior and many others would be rejected as failing to reach the test limits; as the operating voltage is already above that of selenium a market exists for germanium and silicon rectifiers of lower voltage grades. It is, therefore, economical to grade these two new rectifiers.

The d.c. output voltages obtainable from a three-phase bridge rectifier circuit for the various types of rectifier can be summarised as follows:—

Copper oxide	6 V
Selenium	34 V
Germanium	from 40 to 150 V
Silicon	from 40 to 300 V

Fig. 4.—An example of natural air cooling. The folded form of cooling fin provides a large area for heat transfer without occupying a corresponding space. This is a germanium rectifier rated at 80 A



Limitations of Temperature

The reverse resistance of all four rectifiers falls with increasing temperature, thereby increasing the reverse losses, but as the forward losses fall with increasing temperature, and constitute by far the greater part, the total losses fall, and the temperature difference between the rectifier junction, which is the critical part, and the surrounding air or cooling medium will be slightly lower.

In the case of copper oxide the reverse losses cannot be ignored, and a condition of thermal instability may be reached where a rise in temperature produces greater losses so the temperature rise becomes accumulative and the reverse characteristic ultimately collapses. The limiting junction temperature is around 60° C so the rectifier should not be worked above 45°-50° C unless operating at very low voltage where instability is less serious.

Thermal instability is not so readily reached in the selenium rectifier which fails immediately the counter-electrode material melts at a temperature of 160° C. When operated at a junction temperature above 75° C (or 130° C in the case of special selenium rectifiers designed for high temperature use) the reverse characteristics may improve, but in so doing the forward characteristic suffers and serious ageing results with consequent drop in output and rise in temperature.

While ageing at 70° C cannot be ignored, a long life is expected and as few installations reach this temperature for many hours per year, selenium rectifiers usually outlive the useful life of the equipment in which they are incorporated. If the rectifier is operated at a lower temperature, any tendency to age is reduced and so important installations are usually derated on this account.

The germanium rectifier may fail instantly if the junction temperature reaches 90° C. The thermal mass of the germanium wafer is so small that its temperature follows almost immediately any changes in current. A factor of safety is desirable to allow for current surges and intermittent overloads, and a junction temperature of 70° C is usually selected by the rectifier manufacturers; hence, like selenium which is usually designed to operate at the same junction temperature, the current rating must be seriously reduced for higher ambient temperatures.

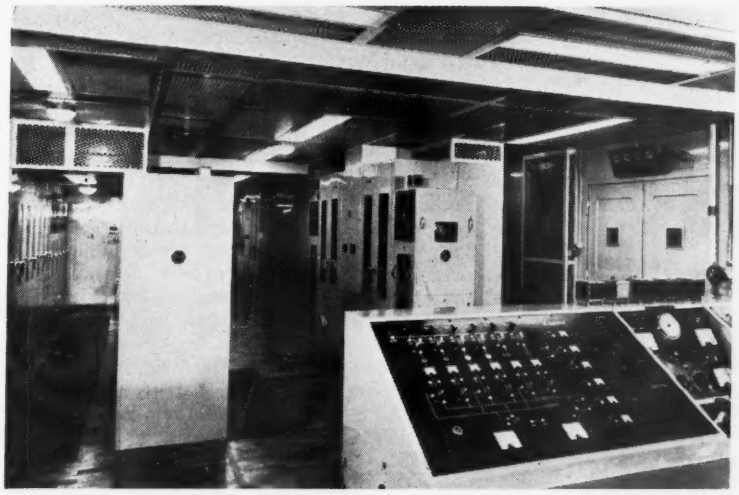


Fig. 5.—An example of oil cooling in which the hot oil is pumped to an external cooler. This selenium rectifier is part of an 800 kW installation designed in 1947. (Courtesy, General Post Office)

The silicon rectifier fails if the junction temperature reaches about 200° C and its thermal mass is even less than that of germanium. A factor of safety is desirable and rectifiers are commonly rated to operate at 150° C. Derating is less critical than for the other rectifiers owing to the far greater margin between the ambient and the limiting junction temperatures. The position is summarised in the following table:—

Type of rectifier	Limiting junction temperature °C	Working temperature of junction °C	Percentage current rating at differing ambients	
			25° C	45° C
Copper oxide	60 (unstable if hotter)	55	100	20
Selenium*	70 (will age if hotter)	70	100	45
Germanium	90 (fails if hotter)	70	100	45
Silicon	200 (fails if hotter)	150	100	90

* Special high temperature selenium rectifiers can safely operate at 130° C junction temperature.

Methods of Cooling

A brief reference to this problem is permissible as the system may affect the installation and running costs of the equipment. Natural air cooling is the simplest and most reliable as no auxiliary apparatus is involved, but the rectifier may be bulky, particularly at higher ambients. Accelerated air cooling by means of fans considerably reduces the bulk of the rectifier. The operation of the fan must be proved and where reliance is placed on a paint film to protect the rectifier from corrosion, the choice of site may be restricted. This problem is less acute with germanium and silicon which must be housed in a sealed casing, but heat transfer may be affected by deposits of dust and air intakes may gradually be restricted and regular maintenance is essential.

Oil cooling has been widely employed for selenium rectifiers providing current to plating processes when the atmosphere is damp and corrosive and the oil adds to the thermal mass to meet short-term overloads. There is no need to use oil if the rectifier is sealed, as are both germanium and silicon, unless operating at a high voltage when clearances under oil can be minimised.

The heat developed by the rectifiers and other losses must be removed from the shop or the local air temperature will increase. On larger installations this may introduce difficulties which can be avoided by transferring the losses outside the room by pumping the oil to an external cooler, or by water cooling the oil and pumping the heated water away. In water-cooled, oil-immersed installations, any leakage occurring in the system may result in water entering the oil which would be serious in a high-voltage equipment and would lead to damage to a selenium rectifier.

If the oil head is sufficiently above that of the cooling water, any pinholes will result in oil leaking to water and drop in head of oil which can readily set off an alarm. Otherwise, reliance must be placed on regular inspection and pressure testing of the water cooling unit which must be readily withdrawn, preferably without shutting down the plant. An alternative system is to cool the outside of the oil tank by clamping a water cooling unit to the tank walls. Any water leakage will then be to the floor and will not contaminate the oil.

An improvement on all these schemes has been applied to heavy current selenium rectifiers which are clamped to a plate associated with a flattened tube through which cooling water passes. The rectifier elements are electrically insulated from the cooling plate, but the heat transfer across the large area is good so the rectifier elements are only a few degrees hotter than the cooling water. This system is now being applied to germanium diodes when the busbar on which they are mounted is itself cooled by contact, through a layer of insulating material, with a water tube.

While efficiency is not of so great importance in smaller equipments where the initial cost per kW is high, first cost

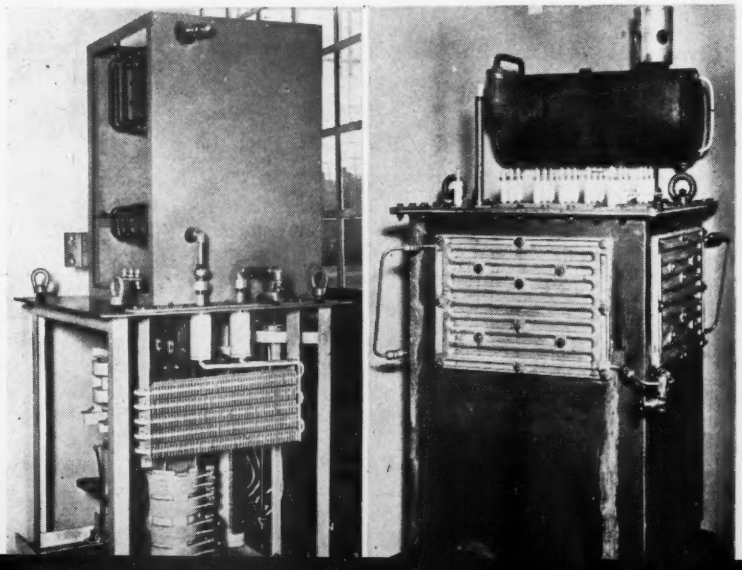


Fig. 6 (left).—Example of water-cooled oil-immersed transformer in which the heat exchanger can be completely withdrawn through the tank lid for inspection. Rectifiers are of the direct water-cooled selenium type shown in Fig. 8.
Fig. 7.—Cooling a h.v. oil-immersed selenium rectifier by external water-cooled heat exchangers

Fig. 8.—Part of an 8 MW 500,000 A 18/24 V installation employing direct water-cooled selenium rectifiers. (Courtesy, The Steel Company of Wales)

largely dictates the economics. The position is likely to be reversed in large installations requiring several MW of power which often operate continuously day and night.

Efficiency

When studying the reverse characteristics we have seen that silicon can deliver 300 V d.c. from a three-phase bridge, using a single diode in series. In this circuit, current passes through two arms of the bridge in sequence so the voltage drop can be related to twice the forward drop of about 1·4 V. The forward losses can then be related to this drop and an indication of efficiency given by comparing output to input voltage. This simplifies the problem but is acceptable here to indicate comparative performances.

As a single bridge of germanium will give up to 150 V, two elements are required in series to deliver 300 V. Similarly, nine selenium and 50 copper oxide rectifiers will be required for this output.

Type of rectifier	No. of series elements per arm	Volt drop per element	Total volt drop in 2 arms	Voltage input = output + total drop	Percentage efficiency, represented by $\frac{\text{input volts}}{\text{output volts}}$
Silicon	1	1·4	2·8	302·8	99·5
Germanium	2	0·7	2·8	302·8	99·5
Selenium	9	1·0	18	318	94·8
Copper oxide	50	0·7	70·0	370	81

At very low voltages, where a single series element can withstand the voltage stress, copper oxide or germanium give the best efficiency; at higher voltages germanium is best, while silicon comes into its own above 100-150 V but at no time does selenium offer the best efficiency.

A study of the efficiencies at various d.c. voltages (Fig. 10) indicates the relative efficiencies of these rectifiers, but copper oxide is not included as it is unlikely to be used for large powers where efficiency is important. It should be remembered that the efficiency of the rectifier only is shown, ignoring losses in transformers and copper connections, which apply almost equally to all types, and tend to mask the differences in rectifier efficiency.

Overload Capacity

Surges of voltage and transient current overloads are often known to occur, while fault conditions may impose overloads which are unexpected, but the user expects a reliable rectifier which is protected against such conditions. Copper oxide is well able to withstand voltage surges and with its high thermal mass can accept current overloads. Selenium is equally able to accept current overloads such as ten times full load for 1 sec, or twice full load for 5 sec, and is not very critical regarding voltage surges.

The high current density at which germanium and silicon operate means that their thermal mass is small and the rectifier junction will rapidly overheat if overloaded. Three times full load for a second is about the limit which the rectifier will stand. Similarly, due to the sharp knee in the reverse characteristics, a voltage overload which stresses the diode beyond the knee results in the rapid destruction of the rectifier. The rectifier engineer must, therefore, take precautions against voltage surges and must allow in his design for current overload and he may have to protect against short circuits.

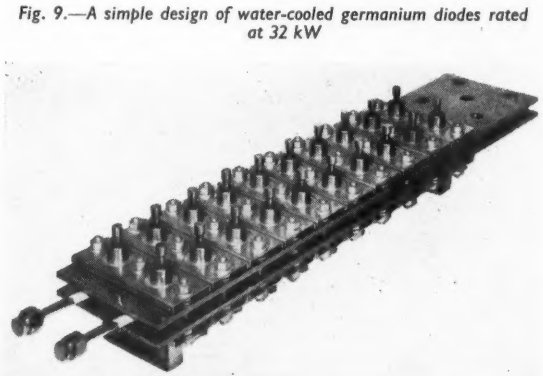
Copper Oxide Rectifiers

The present copper oxide rectifier offers advantages in the field of instrumentation and telecommunication as a small, robust device which has stable characteristics. Thus, for operating a moving coil movement to indicate a.c. voltage or current, a rectifier instrument is available offering all the advantages of the moving coil meter—low power consumption, linear scale, and a robust movement. Ring bridge modulators and demodulators in carrier telephony are applications for which copper oxide has the best characteristics, at least in the lower frequency band, beyond which the lower self-capacitance of germanium puts contact diodes at an advantage.

Literally millions of copper oxide rectifiers are in use as d.c. stoppers in telephone line circuits, where the low forward drop and small leakage current, particularly under surge conditions or when switched on after a period of idleness, are sometimes of great importance. This may not always be so and where greater tolerance can be allowed, selenium offers an alternative choice which is finally decided by economics.

The non-linear forward characteristic is utilised in "crash limiters" where two copper oxide rectifiers are connected in parallel in opposite directions, across a telephone earpiece. The rise of the signal level to a point

Fig. 9.—A simple design of water-cooled germanium diodes rated at 32 kW



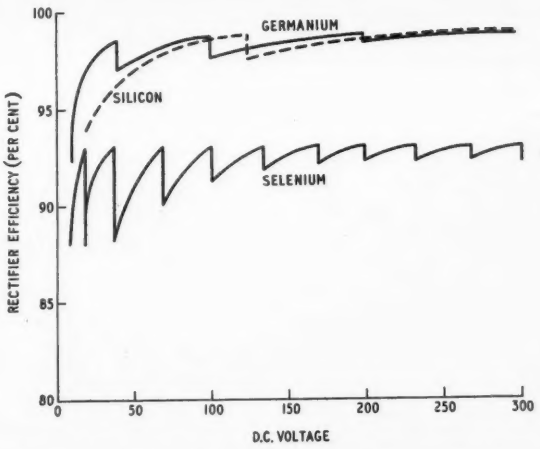


Fig. 10.—Rectifier efficiency at different voltages. The steps denote changes in the number of series elements. Efficiency values do not allow for losses in connections, fuses or transformers, which all tend to mask the differences in rectifier efficiency

at which a painful noise would be caused is avoided by diversion through the forward resistance of the rectifiers.

Recent developments in copper oxide rectifiers have produced a considerably higher reverse resistance so that rectifiers can operate at double the present voltage, with less leakage current and with an even greater stability of characteristic. Their interest to the engineer is still likely to be restricted to existing markets, but if a case can be made for their use in very low voltage, heavy current plants, subjected to severe current overloads (as, for instance, certain welding applications), the rectifier will no doubt be developed to this stage.

Selenium

The main technical difference between selenium and the two newcomers, germanium and silicon, is the lower efficiency and larger bulk of the selenium rectifier. The selenium rectifier, however, does not require the same costly housing which is necessary for germanium and silicon; a single-spindle assembly can form a complete bridge rectifier and so is comparable with a multiplicity of germanium or silicon diodes. Thus for low powers selenium is likely to be by far the cheaper rectifier, while its ability to stand severe overloads can often be utilised to advantage.

The advantages of higher efficiency and reduced bulk offered by the new rectifier are not of vital importance in low power equipments as power consumption is not usually a major item of cost, while the reduction in bulk of the rectifier is masked by the size of the other components. The initial cost and reliability are the two features which usually dominate the purchaser's mind; as germanium and silicon are likely to cost more than selenium their advantages are in general unlikely to outweigh the higher cost.

Selenium is, therefore, likely to remain the best rectifier for outputs up to 5 kW at voltages up to 250 V, while at higher powers the possibility of overloads will influence economics, and at higher voltages the advantage of silicon with fewer series elements will be of importance technically and probably economically. At the low voltage end, electroplating is likely to remain with selenium on relatively low current outputs where short circuits, which will always occur, can be comparable with the output current. For very large plants the effect of a short circuit is small in comparison with the rated current of the equipment and therefore germanium may prove attractive.

In the past, selenium rectifiers have proved successful for many large installations such as electrolytic cells, electrotinning lines, and arc furnaces, where ingenuity has been used to reduce the bulk of the equipment and improvements in the production process have resulted in increased efficiency so that selenium rectifiers giving several megawatts are in operation with efficiencies of 90 per cent and higher. No doubt germanium and silicon will show rather superior efficiencies and reduced bulk, while their economics are not yet fully worked out.

Germanium

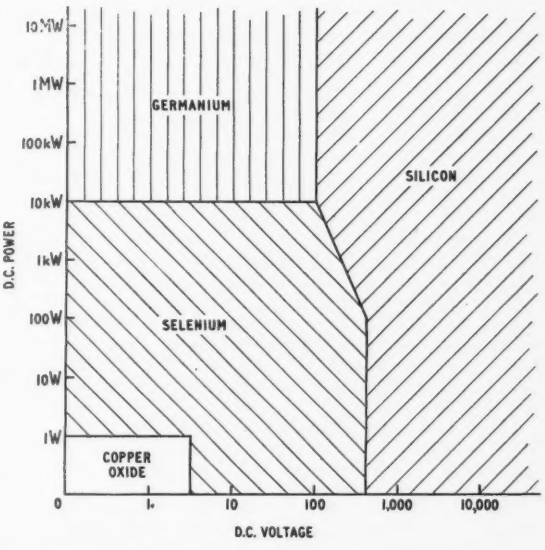
The advantages of high efficiency and small bulk which are characteristic of this rectifier are best appreciated when handling large powers, where these advantages and low running costs will feature largely in the choice of equipment. As has been seen, selenium is likely to be preferable for outputs of up to 5 kW, while the advantages of germanium are more evident for higher powers, say, above 100 kW. Between these rough limits, either rectifier may prove superior depending on operational requirements, room temperature and cooling facilities, coupled with the commercial problems of immediate availability.

Within the limits of d.c. voltage which can be obtained from a single series diode, the efficiency of germanium rectifiers will be superior to that of silicon, but for higher voltages, silicon will generally be more efficient. This voltage limit is around 100-150 V, but again much depends on the relative prices of high-grade germanium diodes suitable for 150 V working and relatively low-grade silicon diodes which might be offered at a lower price.

The temperature limitations imposed by germanium may well rule out this rectifier for tropical duty where room temperatures, allowing for heating by electrical losses, may reach 50 deg C. Water cooling offers an attractive alternative to air cooling in that water is usually cooler and the heat can be extracted from the building as hot water rather than heated air.

Attention must be paid to current overloads should these be substantial, as for instance, in the starting of d.c. motors where currents of several times the normal maximum current may be required for a few seconds.

Fig. 11.—The first choice of rectifier for any power output



The germanium rectifier must be designed to accept these overloads as continuous duty. Precautions must be taken in regard to short circuits as may occur in plating plant, battery chargers, etc., which can be restricted by high transformer impedance though this throws away the advantage of good voltage regulation and increases the kVA input to the rectifier to the level of that of a selenium plant.

Silicon

The technical advantages of silicon are most valuable at voltages above about 100 and at high powers, below which germanium is preferable provided high temperature imposes no severe limitation. At higher voltages and lower powers, silicon offers the advantage of reduced bulk and may compete with selenium, though the cheap construction of the selenium rectifier will probably enable the field to be held for outputs of a few hundred watts at up to 500 V.

Wherever the temperature is very high, or where space and weight are a severe penalty, as in aircraft, silicon power rectifiers are likely to prove advantageous, while the low leakage current at high voltages offers advantages in magnetic amplifier applications. Silicon is unable to withstand overloads and this must be taken into consideration in the design by derating and, if necessary, restricting short-circuit currents by high transformer reactance or other means.

Silicon is, therefore, likely to be used for large electrostatic plants, traction substations, rectifier locomotives and drives for rolling mill and other large variable-speed motors. Until some form of grid control is achieved, control of the output of the silicon rectifier will be costly as the full throughput power must be handled. Silicon is unlikely to accept regenerated current as can a Ward-Leonard set or a mercury-arc rectifier, but many applications may be solved by directing regenerated power into a resistive load.

Summary

The first choice of rectifier for power conversion can be seen by reference to Fig. 11. The boundaries between the areas associated with each type of rectifier are very indefinite and are influenced largely by such operative features as ambient temperatures, overloads which may be expected and voltage regulation. The areas are at present determined by technical merits and estimated costs which will not be confirmed until larger scale production is developed, but it is not thought likely that the pattern will change. However, the design provides a useful guide as to the first choice, which should be confirmed by studying the individual characteristics of the rectifier apparently most suitable, in relation to the required operating conditions. It should be remembered that the silicon rectifier is the only type which offers small bulk and weight at high temperature.

It is clear that the engineer now has a choice of highly efficient and reliable rectifiers which will meet practically all his power conversion problems, and the next two years will see the installation of many plants which will provide a closer understanding of the economics which ultimately decide the engineer's choice.

Electricity in Malaya

THE principal electricity authority of the now independent State of Malaya is the Central Electricity Board, established on 1st September, 1949, when special provision was made enabling the Municipal Commissioners of George Town, Penang, to continue to operate their undertaking. Public supply licences have been granted by the Board to various bodies including the Perak River Hydro-Electric Power Co., Ltd., the Kinta Electrical Distribution Co., Ltd., and Huttenbachs, Ltd. In the year covered by its latest report (to 31st August, 1956) the Board generated or distributed 47 per cent of the total public electricity supplies of the country.

The major power stations are those at Connaught Bridge, Bungsar and Ulu Langat. In May, 1956, the Connaught Bridge station was brought up to its final capacity of 80 MW and preliminary work was completed on a 40 MW station at Malacca, the first part of which is expected to be commissioned at the end of 1958 or early in 1959. The consulting engineers submitted a report on the Cameron Highlands hydro-electric scheme indicating that Stage 1 might produce some 65 MW and later stages could probably raise the capacity to between 150 and 180 MW. A number of smaller hydro-electric developments were investigated and a decision was reached to proceed with the Robinson Falls scheme, which is also in the Cameron Highlands and will ultimately be integrated with the main project.

Proposals by the planning department for transmitting considerable amounts of power from the sources of supply to the areas of major load were tested on a system analyser in the United Kingdom. These tests enabled the decision to be taken to proceed with a very substantial reinforcement and extension of the 66 kV network.

Dealing with the Board's operational results, the report says that these may be considered entirely satisfactory from the technical point of view but from the financial angle "satisfaction must be tempered by the realisation that the Board cannot continue to absorb the very large increases in salaries and wages which have been a feature of the past two years." Tariffs generally have not been increased since 1951 and in some instances have been reduced.

In 1955-56 the Board generated 363·6 million kWh and purchases from other undertakings totalled 52·2 million kWh. Sales rose by 18·3 per cent to 340·2 million kWh while the average price received fell from 9·93 to 9·72 cents per kWh. An additional 17,716 consumers were connected, making the total number 120,862. Income from the sale of electricity amounted to $33 million ($28·5 million), operating expenses being $26·1 million ($21·8 million). After meeting interest charges and contributions to reserves, etc., there was a balance of $1·5 million ($1·6 million). For the seventh year the Board paid a dividend of 4 per cent on its ordinary stock, the whole of which is held by the Government of Malaya. (Malayan dollar=2s 4d.)

The report records a disturbing increase in the number of fatal accidents (from 14 to 22). It points out that fatal results could in some cases probably have been avoided if prompt action had been taken to render artificial respiration, and an intensive campaign is being conducted by the chief electrical inspector to make known this fact as well as the dangers of the improper use of electricity.

At 31st August, 1956, Mr. C. G. Harrison, M.I.Mech.E., relinquished the position of chairman of the Board and was succeeded by Mr. O. A. Spencer, who had previously served from 1952 to 1955. The deputy chairman and general manager is Mr. J. Sharples, B.Sc.(Eng.), M.I.E.E.

E.I.B.A. Year Book

THE 1957 Year Book of the Electrical Industries Benevolent Association has now been issued. As in previous years it includes the annual report of the Council for 1956, the names of the wardens, members of the Council, ex-officio members and members of the Court. There is a list of donations received and one giving the names and addresses of the hon. secretaries of the regional and branch committees.

Nuclear Power

PRINCIPLES AND PROSPECTS

By K. E. B. JAY, M.B.E., B.Sc., A.Inst.P.

HITHERTO man has obtained the bulk of his industrial power from chemical reactions—the combustion of wood or coal or oil—in which energy is released as a consequence of re-arrangement among the outer electrons of the atoms taking part. In the last ten years, however, he has entered an era in which energy can be obtained from nuclear combustion, that is combustion in which the very heart of the atom—the nucleus itself—is disturbed. The outstanding difference between nuclear and chemical combustion is that the amount of energy released by each atom involved is millions of times greater in the former than in the latter.

From a practical point of view, nuclear combustion is the splitting, or fission, by neutrons of the nuclei of certain isotopes of heavy metals, viz. U235, U233 and Pu239. One of these nuclei struck by a neutron splits into two nearly equal parts, with the release of a large amount of energy (about 200 MeV) and of more neutrons. Most of the energy is given up to the two fragments into which the nucleus divides, causing them to move at high speed through the mass of the metal, so heating it. Thus the bulk of the energy appears as heat, although about 10 per cent is released as gamma radiation and fast electrons.

Fission owes its industrial importance to the release of energy, but the crucial fact about the reaction is that it is accompanied by the emission of more neutrons which will cause further fissions; thus it is possible for self-sustaining fission chain reaction to spread through the metal. In this respect fission is unique among nuclear reactions, which are not generally self-sustaining. The number of these fresh neutrons averages 2·5 and provided one of these, on the average, causes another fission, the reaction will continue at a steady rate as long as there are fuel atoms present.

Nuclear Fuels

The only naturally-occurring nuclear fuel is the lighter of the two principal isotopes of uranium, viz. U235. Natural uranium contains only 0·7 per cent of this isotope; the remainder is U238 (apart from a trace of U234) and this is not fissile by slow neutrons. But U238 can capture a neutron and be transmuted (after radioactive changes) to Pu239, which is fissile. Thus U238 also is, at least potentially, a nuclear fuel. In a similar manner another non-fissile element, thorium, can be regarded as a potential fuel because its isotope Th232 is transmuted by neutron bombardment to another fissile isotope, U233. These three—U235, Pu239 and U233—are the principal fuels of the atomic age.

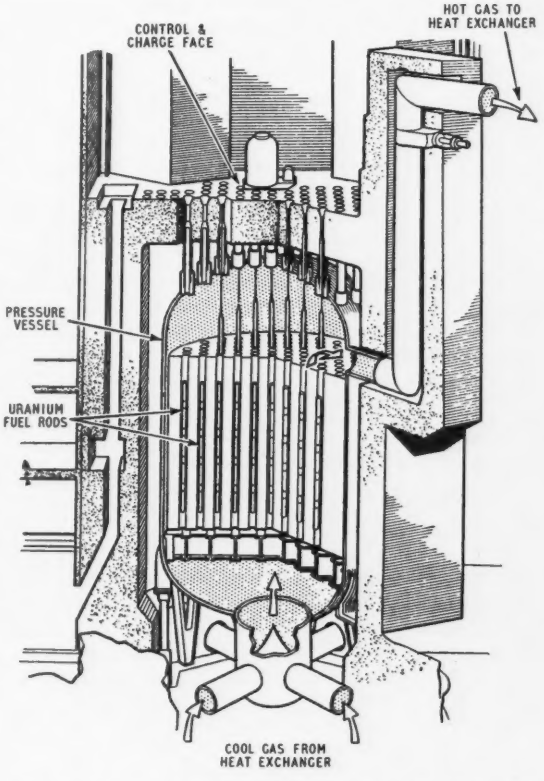
Any new fuel is of interest to a world which doubles its consumption of energy every ten years and has only limited reserves of conventional fuels. This is the first reason for the importance of nuclear fuels. The second is their extraordinary compactness compared with conventional fuels. A pound of uranium completely burned would do the work of 1,300 tons of coal; this property of nuclear fuel opens many possibilities for power units in inaccessible places or in ships and, ultimately, aircraft.

Nuclear fuels are burnt in nuclear reactors or atomic piles which can most usefully be classified in terms of the energy possessed by the neutrons when they cause fission. Neutrons emerge from a fissioned nucleus with very high energy, in the region of 2 MeV. These are called fast neutrons and a reactor which depends upon them is called a fast reactor. A fast reactor will work only with nearly pure fissile material. If, however, the neutron energy is reduced 10^{-8} times, i.e. to about 0·025 eV, it becomes possible to maintain a chain reaction in natural uranium even though it contains only a small proportion of fissile atoms. A reactor which depends upon these slow or thermal neutrons is called a thermal reactor.

The required reduction in neutron energy is brought about by allowing the neutrons to collide with the atoms of some light material, called a moderator, until neutrons and moderating atoms are in thermal equilibrium. The most effective moderating materials are those whose nuclear masses are most nearly equal to the mass of the neutron. Some of these light atoms absorb neutrons strongly, which limits the choice of materials in practice. Useful materials are hydrogen and deuterium, usually in the form of water or heavy water, beryllium (or its oxide), and carbon in the form of graphite.

Thermal Reactors

Thus the primary requisites for a thermal reactor are fissile material and a moderator. Usually, discrete lumps



Arrangement of core inside pressure vessel of graphite-moderated gas-cooled reactor

of the fissile material, in the form of rods or plates, are disposed in a regular lattice array in a large block of moderator. By using the fuel in lumps like this non-fission-producing absorptions of neutrons in U238 are reduced relative to fission-producing absorptions in U235.

The next requirement is some means for controlling the reaction. In thermal reactors this is usually done by inserting rods of neutron-absorbing material (boron, for example) into the core of fuel and moderator. The quantity of absorber is adjusted so that it removes all surplus neutrons, thus causing the reaction to be maintained at a steady rate. If the quantity of absorber is reduced a little there will be spare neutrons so that each generation of fissions is followed by a larger generation—the fire gets hotter and the power level of the reactor rises. Power can be stabilised at any desired level by putting the absorbers back to, roughly, their original position. The converse procedure is followed to reduce power.

Then in a power reactor some means must be provided for removing the heat released. Often this is done by pumping a gaseous or liquid coolant over the surfaces of the fuel rods, which are laid or suspended in cylindrical channels in the moderator. Finally, the reactor must be surrounded by a shield, of suitable material and size, to prevent neutrons and gamma radiation from reaching the operators.

There are many ways in which fuel, moderator, and coolant can be arranged, but of these only a few are worth developing into a practical system. The archetype is the one using graphite as moderator, natural uranium as fuel, and gas as coolant, exemplified in its latest form by the Calder Hall reactor (see *Electrical Review*, 19th October, 1956). In this the reacting core is a vertical cylinder of graphite (built up from thousands of accurately-machined bricks) through which run vertical channels. In these stand the fuel elements, rods of natural uranium enclosed in magnesium-alloy cans fitted with annular cooling fins; the purpose of these cans is to prevent the oxidation of uranium and the escape of the radioactive fission products. This core is surrounded by an annular reflector of graphite to return into the core some of the neutrons that would otherwise have escaped.

The whole core and reflector are enclosed in a steel pressure vessel. Carbon-dioxide gas, at 100 lb/sq in, is blown into the bottom of this vessel. It passes up the fuel channels, removing heat as it goes, and is led out at the top through four conduits to four heat exchangers, in which steam is raised to drive turbo-generators. The nuclear reaction is controlled by rods of boron steel. The reactor proper in its pressure vessel is surrounded by a 3in steel thermal shield and an 8ft concrete biological shield for protection against radiation.

Limitations of Natural Uranium

The datum from which the Calder Hall reactor was developed was the choice of natural uranium as fuel. This fuel has the advantage of being relatively cheap but it can be used only if great care is taken to avoid waste of neutrons. Among other things, this necessity limits the choice of moderator. Graphite is suitable, provided it is very pure, but leads to a large reactor. Heavy water is a more efficient moderator than graphite, but it is very expensive. Ordinary water is an effective moderator but has the drawback that it absorbs neutrons rather strongly and so can be used only if the fuel is enriched by increasing the concentration of fissile material.

Limitation to natural uranium also restricts the choice of coolant to a few gases, notably helium, carbon-dioxide, and hydrogen and to light and heavy water. By enriching the fuel it becomes possible to use other liquid coolants, including liquid metals, with their superior heat transfer properties.

Fuel Utilisation

We must turn now to the important question of fuel utilisation or burn-up. Since only 0·7 per cent of natural uranium is fissile U235, it might be supposed that not more than 0·7 per cent of the fuel could be burnt and that the remaining 99·3 per cent would have to be thrown away. This is not as bad as it sounds because even at 0·7 per cent utilisation, a ton of uranium would give the same heat output as about 20,000 tons of coal and, at current prices, would cost about a quarter as much.

But it is possible to burn a considerably greater proportion than this. This possibility depends on the two fundamental facts that U238 is converted by neutron absorption to fissile Pu239, and that fission is accompanied by the release of about 2·5 new neutrons. Clearly, if some of these new neutrons were absorbed by U238, new fuel atoms would be formed which could be burnt in their turn. In short, some of the "unburnable" U238 would be made burnable (indirectly) and the total proportion of usable fuel increased above 0·7 per cent.

Just how big an increase could be achieved depends on the neutron balance of the reactor, that is the fate of the 2·5 neutrons per fission. Of this number, one will be needed to maintain the chain reaction; of the remaining 1·5, part will be lost by absorption in materials in the core or control rods, part will escape, and part will be captured by U238 to produce plutonium. The number of fresh fissile atoms (plutonium) produced for each fission is called the conversion factor, C. Generally, C is less than 1 and the maximum increase in burn-up is then $\frac{1}{1-C}$ times. Thus, if C were 0·6 the maximum burn-up would be increased 2·5 times, from 0·7 to 1·75 per cent. If C exceeded 1, more fresh fuel could be produced than was burned, giving the possibility, in principle, of burning 100 per cent of the uranium. Such a process is often called breeding.

It is not possible to leave the fuel charge in a natural uranium reactor until all the U235 and plutonium atoms are burnt, for two main reasons, viz. first, that the fuel elements are damaged by the irradiation to which they are subjected and, second, that the neutron balance is not maintained owing to changes in the composition of the fuel. Considering the first of these: owing mainly to the replacement of one uranium atom by two fission-product atoms, the uranium metal is distorted by irradiation and this may lead to damage to the fuel element which would interfere with the operation of the reactor. Experience so far indicates that this effect limits the practicable irradiation of natural uranium, expressed in terms of the heat obtained per tonne of uranium, to about 3,000 MW day/tonne, though it may be possible to raise this limit, and the operating temperature, by suitable metallurgical techniques. Turning to the second effect, the changes in composition arise from the formation of fission products—nuclear ashes—from the splitting of fuel atoms. Some of these fission products absorb neutrons strongly and tend to stop the chain reaction; obviously, therefore, the fuel must be removed before this poisoning, as it is called, puts the nuclear fire out. Again, it seems that the estimate of 3,000 MW days/tonne for the irradiation limit fits in with these poisoning effects on reactivity. In natural uranium irradiated to 3,000 MW days/tonne, about 0·35 per cent of the U235 is consumed, or one ton of the fuel gives as much heat as 10,000 tons of coal.

What is done with fuel irradiated to the limit just discussed depends upon several factors, mainly economic. For example, if cheap, natural uranium is available, the burnt fuel might be thrown away. Alternatively, it might be treated chemically and the worst poisons removed; the fuel might then be put back in the reactor with the plutonium left in it, or uranium and plutonium might be separated and used in different reactors. Cost of processing and alternative reactors are among the factors that will decide the choice.

Breeding and Breeder Reactors

The whole question of utilisation and fuel cycles is complicated, depending as it does upon economic as well as technical considerations. For example, a few years ago it was considered that something like 100 per cent utilisation, and consequently breeding, would be necessary before construction of nuclear power stations in large numbers could be entertained, but the discovery in recent years of much larger quantities of exploitable uranium ore has modified this view considerably. However, breeding is nevertheless an important aim of long-term development and several types of breeder reactor are being studied.

In one form, a breeder reactor consists of a reacting core surrounded by a blanket of fertile material (U238 or thorium) in which neutrons leaving the core produce new fuel atoms. Fast reactors are particularly promising breeders because, as there is no moderator in the core and the fuel is highly concentrated, there are more spare neutrons than in a thermal reactor—the neutron balance is favourable to breeding.

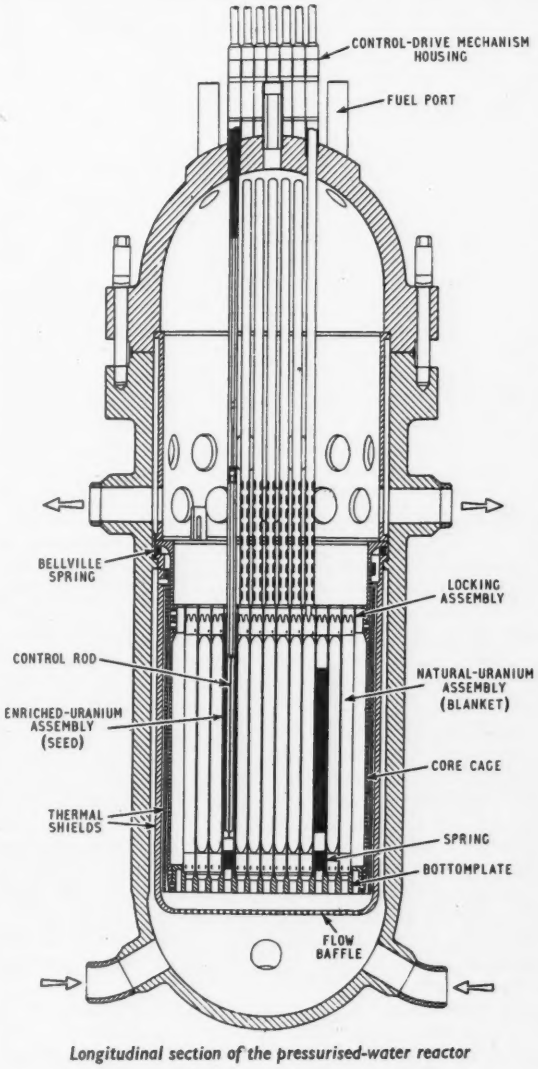
Experiments in ZEPHYR, the low-power plutonium-fuelled fast reactor at Harwell, suggest that in a full-scale power-producing fast reactor 1·7 atoms of fresh fuel should be produced for every plutonium atom burned in the core. A fast reactor producing 60 MW of heat is being built by the U.K.A.E.A. at Dounreay in Scotland; this will be used to study the technology and operation of the type on the plant scale. Fast reactors present formidable problems to the engineer principally because their heat ratings are exceedingly high—the 60 MW of heat at Dounreay is produced in a core not much bigger than a household dustbin.

Breeding is much harder to achieve in a thermal reactor, but it appears to be possible in systems burning U233 and breeding fresh fuel in thorium. Some of the more promising of these systems use their fuel in the liquid, instead of the solid, state. One of them is the aqueous homogeneous system which has been much studied in the U.S.A. and also at Harwell. In this system, fuel atoms are uniformly dispersed among moderator atoms by dissolving a salt of uranium in water, e.g. uranyl sulphate (enriched in fissile uranium) in heavy water. This core would be contained in a sphere, possibly made of zirconium, and be surrounded by a slurry of thorium particles forming the breeding blanket. The principal advantages are that the troubles associated with metallic fuel elements are avoided and that it is possible to remove fission products continuously. Ratings can be high and the reactor is stable and has good self-regulating problems. On the other hand, the radioactive core solution presents some appalling problems of corrosion.

In another liquid-fuelled reactor, which is also being studied in America and at Harwell, the uranium is dissolved in a liquid metal, bismuth for example. The principle could be applied to both fast and thermal reactors though most attention seems to have been paid to thermal types using graphite as moderator. Again, the blanket would probably be a thorium slurry. This system would operate at low pressure and at a higher temperature than the homogeneous aqueous system, but it also presents difficult corrosion and mass-transfer problems.

Gas-Cooled Power Reactors

A very great deal of research and development remains to be done before any of these breeder systems can produce cheap electric power. For the next few years Britain has pinned her faith to gas-cooled graphite-moderated reactors developed from Calder Hall because these are simple, robust, safe and do not demand exotic materials of construction. Straightforward engineering improvements on the Calder Hall design (particularly in constructing the pressure vessel) have resulted in designs for the first power stations in which output is increased about four times. Thus, the proposed Scottish station will give about 320 MW net of electricity. The capital cost is high—£35 to £40 million for the Scottish station—but fuel costs are about one-third those of coal at current prices. The overall result is that, assuming operation as base-load stations and appropriate amortisation charges, the electricity from these stations will cost about the same



Longitudinal section of the pressurised-water reactor

as that from the average coal-fired station, though slightly more than electricity from our most modern coal-fired station—not bad for the first of their kind. Further engineering development may reasonably be expected to reduce capital costs still more in quite a short time. Technological development will lead to higher fuel-element temperatures so that by 1970 it may be possible to raise gas temperatures to as much as 500 deg C.

Nor is that the end of the gas-cooled reactor story. By combining highly-enriched fuel with moderator in the fuel elements the effective surface area presented to the coolant may be enormously increased. The result would be a very large increase in heat rating and operating temperature and consequent reduction in capital cost per kW sent out. Fuel burn-up should also be high, so fuel costs would be reduced. This system, which is generally (if perhaps ambiguously) described as the high-temperature gas-cooled reactor, now has high priority in Harwell's research programme.

Other Thermal Power Reactors

France, like Great Britain, is developing the gas-cooled power reactor, but America and Russia are putting their principal emphasis on liquid-cooled systems. Probably this difference reflects the availability in these countries of enriched uranium. Thus, the first American nuclear power station, at Shippingport, Pennsylvania, will make use of a pressurised-water reactor—it is in fact known as the p.w.r. This reactor consists of a fairly small core of enriched uranium enclosed in a pressure vessel 9ft in diameter, welded from 6in steel plate.

The moderator and coolant is ordinary water, pumped in a closed circuit through the reactor vessel to external heat exchangers in which steam is raised. To prevent boiling, the system is maintained at a pressure of 2,000 lb/sq in. The Americans have had experience with a smaller version of this type of reactor in their nuclear-powered submarine, the U.S.S. *Nautilus,* and are developing it in several different forms. It has the advantages, compared with gas-cooled reactors, of small size and high rating, leading to rather low capital costs; on the other hand, the fuel costs will be higher. The principal difficulties arise from the extremely corrosive nature of water; expensive zirconium alloys will be needed to sheath the fuel elements.

A related type is the boiling-water reactor. The essential difference between this and the p.w.r. is that the water is allowed to boil and the steam produced is led straight to the turbines. By thus eliminating the heat exchanger the plant is considerably cheapened. Experiments have shown that, contrary to earlier opinion, operation is stable in spite of boiling. Corrosion will be a problem, as in the pressurised-water reactor, and the fact that the steam admitted to the turbines will be slightly radioactive has caused misgiving, but the type is regarded as a promising one in the U.S.

Until lately the use of heavy water in power reactors has attracted less attention except in Canada, where a 20 MW (electrical) demonstration plant is being built at Des Joachims, Ontario. This reactor will be cooled and moderated by heavy water and fuelled with natural uranium. Recently, the U.S.A. has begun the study of a sodium-cooled heavy-water system and the Russians are reported to be working on a heavy-water system cooled by carbon-dioxide. Heavy water is, of course, expensive and it also presents similar corrosion troubles to light water.

Another liquid-cooled thermal reactor, studied in the United Kingdom as well as in the U.S.A., is the sodium-cooled graphite-moderated system. The advantages expected of this are high-temperature operation combined with low system pressure. The disadvantages arise principally from incompatibility of sodium with other materials and from poor neutron economy. The capital costs would have to be low for the reactor to be economical in operation.

Small Power Reactors

The need in industrial countries for power in large blocks, combined with the high capital cost of reactors, has caused attention to be focused mainly on large plants. But there is a demand for much smaller power units, from, say, 5 to 30 MW, for electricity supplies in under-developed or remote areas and for propulsion, especially of ships, and work on this application has been done in several countries. Besides the pressurised-water reactor in the *Nautilus,* the Americans are using this type in their army package power reactor, a 2 MW electricity generating station which can be transported in sections by air.

Another promising system for propulsion, which is being studied at Harwell as well as in the U.S.A., uses an organic liquid as moderator and coolant. This idea is not new; organic liquids have high concentrations of hydrogen and therefore good moderating characteristics, but they are generally unstable to radiation and it is only lately that chemical research has shown that some polyphenyls, notably diphenyl, are reasonably stable. The advantages of the type, compared with pressurised water, are low operating pressure and high temperature combined with a less corrosive liquid. Slightly enriched fuel would be needed.

Although gas-cooled reactors tend to be large they are by no means ruled out for plants giving about 30 MW. The high-temperature gas-cooled reactor, in particular, may well have possibilities in the future.

General Prospects for the Future

There has not been space in this article to do more than glance at the reactor systems which seem most promising for electricity generation. In considering the economics of nuclear power it is essential to take into account the cost of fabricating fuel elements and of processing them chemically to remove fission product poisons and, probably, newly-bred fissile material. Developments tending to reduce the cost of these processes would be as important as developments in reactors themselves.

Five years ago there was much argument as to whether nuclear power could ever be competitive with coal power. Now the question is not whether, but when. The answer differs from one country to another. In the United Kingdom there is every reason to believe that the first power stations, which will begin operation in the early 1960's, will generate electricity at a cost comparable with that of coal-fired stations. In the U.S.A. costs of power from conventional stations are lower, and amortisation charges higher, than in this country, so it will be longer before nuclear power is economic. This, fundamentally, is the reason for the more broadly-based development programme in the U.S.A. as compared with ours. The economic considerations operating in the U.S.S.R. are less clear, but the Russians, too, are studying a considerable number of types. Nevertheless, it is interesting to note that, in terms of kW of installed generating capacity, the programmes of the three major atomic energy powers are quite similar. The U.S.A. expects to have 1,200 MW by 1960 and the U.S.S.R. 2,500 MW by 1965; the special circumstances of the United Kingdom will lead to more rapid expansion, and the revised programme announced by Lord Mills in March calls for 5,000 to 6,000 MW by 1965.

VIEWS on the NEWS

By REFLECTOR

ONE of the occupational hazards of the chairman of the board of a nationalised industry is to be the focus of criticism for anything that happens in his domain, be it never so far from the centre. Recent eulogies of Lord Citrine for his work on the Central Electricity Authority are therefore praise indeed. One of the nicest tributes was one which appeared in the *Manchester Guardian* last week. It made reference to his imminent relinquishment of his chairmanship and termed him the "man who has been the successful head of the country's biggest successful business for nearly a decade." It concluded as follows:

> "There is so little of the snob in him that he would be content to eke out his days driving a turbine in one of the smaller power stations if no more exciting job should present itself."

* * *

Although the reports of the Electricity Boards largely follow a standard format they have their distinctive features. For example, those of the South Eastern and East Midlands Boards contain individual reports by each of the district managers. These, I am sure, must provide a good deal of interesting material for local newspapers who are not so concerned with the wider activities of the Boards. I observe from Mr. R. G. Widgery's report that the Dover District sold 30 per cent more electricity than in the preceding year which must be one of the largest increases in the country. A sizeable contribution to this high consumption figure, incidentally, was made by the enlarged gasworks of the South Eastern Gas Board.

* * *

Commenting upon a report in the *Daily Telegraph* of the transport by road of a 168-ton transformer a correspondent says that such "huge monstrosities" should not be allowed on the roads because of their effect upon ordinary motor traffic. He says that "the last straw is when we see the police helping to clear the roads for them, when the law of the land should send police to prosecute the pirates who launch them." Actually, the movement of large items of electrical equipment is most carefully planned so that the least possible interference with traffic is caused. Such loads are generally not suitable for the railways. How does the *Daily Telegraph* reader propose to deal with them—by helicopter?

* * *

"Crabbed age and youth cannot live together." Nor can modern street lighting and "period" architecture apparently. I have already referred to Sir Albert Richardson's protest against the Ampthill lamp standards and to earlier cases of incompatibility. There is at present trouble at St. John's Wood, London, where the St. Marylebone Borough Council has incurred the displeasure of some residents by proposing to install sodium lighting. In this instance the main objection is to the light itself; the protestants would appear to favour fluorescent lighting if they must have any. But they have also expressed adverse views on the lamp standards which it is proposed to erect. The chairman of the Council's Works Committee says that efficient lighting must be the main consideration in these days: street "furniture" cannot be made to harmonise with ancient backgrounds. I do not believe it to be impossible to avoid total disharmony although I realise that efficiency and antiquity are hard to reconcile.

* * *

How a soft answer turned away the wrath of a disgruntled consumer is related in the October magazine of the Eastern Electricity Board. This consumer complained in more than forthright terms that whenever there was a flash of lightning in his vicinity his supply was cut off and the Board was doing nothing about it. He wrote:

> "There is too much of it to be due to just bad luck. Obviously it's the usual story of the petty dictatorship set up by the monopoly of nationalisation, operating on a basis of 'you can't get it from anyone else so put up with our gross inefficiency or do without.'"

In a courteous reply the Board pointed out that it was technically impossible to make overhead lines completely invulnerable to lightning effects and outlined the strenuous efforts which its staff made to restore supply after breakdowns. After saying that it was hard to accept that a nationalised industry was not blameworthy for the "trials and tribulations" which arose at times, the consumer confessed that the Board's explanation was "reasonable, sound and beyond dispute." He apologised for his criticism of the staff.

* * *

One of the items in the *Electrical Review* of 4th October, 1907, was a report of the Municipal Tramways Convention at Manchester. In the course of this it was stated that Mr. J. Aldworth (Nottingham) was elected president and Mr. A. L. C. Fell (L.C.C. Tramways) vice-president. Later, it was reported, Mr. Fell read a "somewhat unconvincing paper on the vexed question of rail corrugation." Older London readers will recall with delight that every L.C.C. tramcar during Mr. Fell's reign bore (in conformity with regulations) the manager's full names—"Aubrey Llewellyn Coventry Fell." I also remember that *Punch* once published a set of verses in each of which this beautifully rhythmic appellation was ingeniously used.

This reminds me of another metrical fragment that used to be seen in L.C.C. tramcars:—"Do not pass behind the car until you see the road is clear."

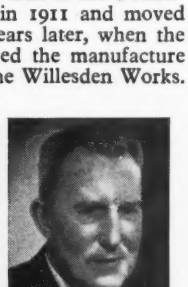
PERSONAL AND SOCIAL

News of Men and Women of the Industry

Mr. J. M. Goodall, M.I.E.E., consulting switchgear engineer at the Willesden Works of the British Thomson-Houston Co., Ltd., has retired after forty-nine years' service. The presentation of a gold watch, a gift from his friends and colleagues, was made to him by Mr. C. F. Humphreys, manager, Switchgear Engineering Department.

After studying at Finsbury Technical College (now City and Guilds) under Silvanus P. Thompson, Mr. Goodall in 1908 commenced an engineering apprenticeship with the B.T.H. Co. He joined the staff of the Switchgear Department in 1911 and moved to London, two years later, when the company transferred the manufacture of switchgear to the Willesden Works.

Mr. J. M. Goodall



Mr. A. S. Kettle

He was appointed tender engineer in 1922, and chief switchgear engineer in 1928, and became consulting switchgear engineer in 1955.

Mr. Goodall has travelled considerably on behalf of the company, spending a year with Associated Electrical Industries in India (1946-47), followed by four months in Australia and a similar period in New Zealand. He served on the Utilisation Section Committee of the Institution of Electrical Engineers from 1948 to 1952.

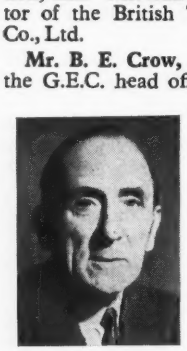
After forty-six years' service with the British Thomson-Houston Co., Ltd., **Mr. A. S. Kettle,** M.I.E.E., retired at the end of September. In May of last year he was succeeded as manager of the B.T.H. Construction Department by Mr. D. Allsop, since when he has been consultant to the Construction Department and Service Engineer's Department.

Mr. Kettle received his training with the Bournemouth and Poole Electricity Supply Co., before going to Rugby in 1911 to join the B.T.H. Testing Department. In 1915 he was appointed chief-of-test, a position he held until 1928 when he was appointed service engineer. During the last war Mr. Kettle was seconded for duty as manager of the Brimsdown Works of the A.E.I. group engaged on the production of electronic components for the Services. He returned to Rugby in 1946 and two years later became manager of the Construction Department, responsible for plant erection and maintenance outside the B.T.H. factories. He was president of the Rugby Engineering Society for 1939-40.

The Central Electricity Authority has appointed **Mr. A. Chorlton,** A.M.C.T., A.M.I.E.E., to be system design and development engineer at Authority headquarters. After receiving his technical education at the Manchester College of Technology, Mr. Chorlton took up his first appointment with Ferranti, Ltd., and in 1935 joined the Technical Department of the Central Electricity Board. He served until 1946 at the Board's South East England headquarters as specialist engineer on measurements and protective relays. On the establishment of the Authority Mr. Chorlton joined the system design and development sub-branch of the Chief Engineer's Department at headquarters, becoming principal assistant in 1951. In this capacity he has been concerned with the detailed design of the Authority's transmission systems, including the 275 kV supergrid.

Mr. E. H. Ball has been appointed a director of Power Securities Corporation, Ltd. Mr. Ball is managing director of the British Thomson-Houston Co., Ltd.

Mr. B. E. Crow, senior traveller at the G.E.C. head office, retired at the end of September. He has been associated with the electrical industry since 1905 when he joined the Sterling Telephone Co. In June, 1931, Mr. Crow undertook the responsibility of developing G.E.C. business with wholesale distributors in the London area, and he was appointed senior traveller at the head office in 1950.

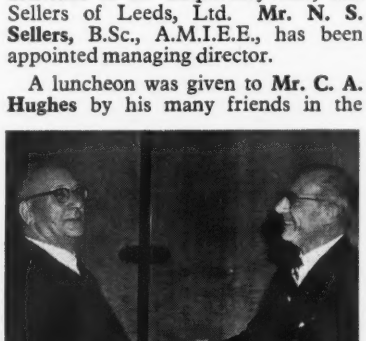


Mr. B. E. Crow

Mr. R. A. West, B.Sc.(Eng.), A.M.I.E.E., has joined the board of Contactor Switchgear, Ltd. Mr. West was educated at Oundle School and served his apprenticeship with the Igranic Electric Co., Ltd., with whom he became a technical director in 1949. Since 1954 he has been assisting Mr. J. F. Liwski, joint managing director of Contactor Switchgear, Ltd. For some years he was a member of the technical committee of B.E.A.M.A. for motor control and he has acted as consultant for the electrical activities of B.I.S.R.A. Mr. West is the author of "Electric Traction for Cranes," "Multi-Motor Traction for Cranes" and a number of technical papers on control gear and associated subjects.

Mr. H. Wadsworth Sellers, O.B.E., has been appointed as chairman of Caselco, Ltd., electrical wholesalers, which (as we report elsewhere in this issue) has taken over the trading activities of G. Casperson, Ltd., and Sellers of Leeds, Ltd. **Mr. N. S. Sellers,** B.Sc., A.M.I.E.E., has been appointed managing director.

A luncheon was given to **Mr. C. A. Hughes** by his many friends in the lamp-making industry on 23rd September, at the Savoy Hotel, London, to mark his retirement from the industry, and the occasion was taken to present him with a gold bracelet for his watch.



Mr. C. A. Hughes (left) receiving a presentation from Mr. A. E. Page on behalf of his friends in the lamp industry

Dr. K. R. Sturley, head of the Engineering Training Department of the B.B.C., is visiting the United States this month to study methods of training in broadcasting and radio engineering. He will see the work of the chief American broadcasting networks in New York and Chicago and the training methods used in industry and selected technical institutions in Washington, Cleveland and Boston.

Mr. R. F. Masters, who for the past two years has been editor of the *B.E.A.M.A. Journal,* has joined the editorial staff of the *Electrical Review.* Before going to the *B.E.A.M.A. Journal* in 1950 Mr. Masters was with Marconi's Wireless Telegraph Co., Ltd., and Standard Telephones & Cables, Ltd.

Mr. H. Edmonds, an executive director of Oldham & Son, Ltd., and head of its Export Department, has left on a 20,000-mile tour which will include Baghdad, Tehran, Abadan,

Basra, Colombo, Singapore, Kuala Lumpur, Hong Kong, Bangkok, Rangoon and Beirut.

Mr. H. G. Showell has been appointed registrar of Metal Industries, Ltd., in succession to the late Mr. J. Law. Mr. Showell has been assistant registrar of the company since 1950.

Mr. D. Freedman has been appointed deputy managing director of the Kenwood Manufacturing Co., Ltd. He became a director two years ago.

Mr. K. E. B. Jay, the author of the article "Nuclear Power: Principles and Prospects" (page 593), read for an honours degree in physics at University College, London, where he carried out research in metal physics under Prof. E. N. da C. Andrade, F.R.S. He worked on radar for the R.A.F. at the Telecommunications Research Establishment throughout the war, and after a period in the Official War Historian's Department, joined the Atomic Energy Research Establishment, initially as information officer, in 1947.

Mr. K. E. B. Jay

Mr. H. W. Shipton, of the Burden Neurological Institute, Stapleton, has been appointed research associate in medical electronics at the State University of Iowa.

The Radio and Telecommunications Section of the **Institution of Electrical Engineers** visited the Netherlands from 18th to 22nd September, the tour including a visit to the Philips organisation at Eindhoven, where Mr. F. J. Philips, vice-president of the board of management of the Philips companies, welcomed the visitors at lunch. There was also a dinner the same evening. On the following evening Dr. R. C. G. Williams (chairman of the Section) presided at the Institution's dinner and dance to their Dutch hosts in Amsterdam. While in the Netherlands a visit was paid to Arnhem Memorial, where Dr. Williams laid a wreath on behalf of the Institution.

A dinner was given at Wakefield on 16th September to **Mr. A. Milner,** director and secretary of the Spencer Wire Co., Ltd., to mark his completion of fifty years' service with the company. Mr. C. D. Gill (chairman), in making a presentation of a silver tea service to Mr. Milner, referred to his loyalty and devotion to the company, and Mr. Milner, in expressing his thanks, spoke of the changes which had taken place over the past fifty years. Mr. Milner joined the company as an office boy at the age of sixteen and succeeded his father as secretary in 1924. He was elected a director in 1954.

The Electrical Research Association announces that **Mr. L. Gosland** has been appointed research manager of the Association and **Mr. E. E. Hutchings** head of the Member Relations Department. **Mr. A. M. Cassie** and **Dr. L. H. Orton** will be joint heads of the Switchgear Department, and **Dr. G. Mole** and **Dr. F. Busemann** head and deputy head, respectively, of the Transmission and Utilisation Department.

The annual swimming gala of **W. T. Henley's Telegraph Works Co., Ltd.,** was held at Eltham Baths on 20th September and a large gathering, including Sir John Dalton (chairman), enjoyed an interesting evening's sport. Races between teams from the company's head office and works formed the main events, while other items in the programme included a bathing beauty competition, a diving display, a display of ornamental swimming and a water-polo match. Swimming is the deciding event in the annual City Livery Club Cup competition. This competition between the head office, Engineering Department, Woolwich Works, Gravesend Works, Research Laboratories and Tyre Company, covers a wide range of sports. This year the cup was won jointly by head office, research laboratories and Engineering Department, and was presented by Mr. S. J. Beaney (director and secretary) to Mr. S. H. Wilkins (staff officer), Mr. W. C. Barry (manager, research laboratories) and Mr. H. C. Hoban (manager, Engineering Works), respectively, representing the winners.

Members of the I.E.E. Radio and Telecommunications Section at Arnhem. Left to right: Sir Harold Bishop, Mr. A. H. Mumford, Major B. Binyon, Dr. R. C. G. Williams, Mr. C. E. Strong and Mr. H. Stanesby

Mr. A. M. Taylor, M.A., F.C.I.S., secretary and commercial manager of Foster Transformers, Ltd., has been appointed a director of the company. Mr. Taylor, who joined the Lancashire Dynamo organisation in 1948, has been commercial manager of the Foster Co. since that time, becoming secretary in 1953; he is also secretary of Foster Electrical Supplies, Ltd. Mr. Taylor is a member of the Bar of the Middle Temple.

Mr. A. M. Taylor

The annual competition for the **Electrical Trades Commercial Travellers' Association** Midlands Branch challenge golf trophy was held at Moor Hall Golf Club, Sutton Coldfield, recently; a visitors' competition was also arranged. The prizes were presented by the Branch chairman, Mr. C. J. Nash. The winner of the challenge trophy was Mr. H. Martin and other prizewinners included Messrs. D. J. Hinton and J. T. Aitken. The visitors' prize was won by Mr. F. Williams.

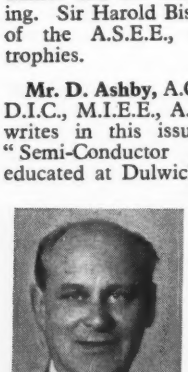
The General Electric Co., Ltd., announces that its Household Appliances and its Domestic Equipment Sales Departments have been merged into a single Domestic Equipment Department under the management of **Mr. Ivor Williams,** M.B.E., T.D. Mr. Williams will be responsible for the home and export sales of the company in this field. This follows the recent announcement that **Mr. C. R. Duncombe,** manager of the Household Appliances Department, had decided to retire at the end of the year. Mr. Williams has been manager of the Domestic Equipment Department of the G.E.C. since 1948. Before that he was with the company's South Western Area branch at Cardiff. He is chairman of the Domestic Electric Cooker Section of B.E.A.M.A.

Mr. I. Williams

The September meeting of the **A.S.E.E. Golfing Society** was held recently at Mill Hill Golf Club. A Stapleford round was played for the "Thermodare" trophy. The winner was Mr. C. E. Furness and the runner-up Mr. M. A. E. Langsdon. Other prizes were won by Messrs. Emberson, Shortt and Dowsett and the wooden

spoon by Mr. J. Gillespie. The final meeting of this season will be held at the Wimbledon Park Golf Club on 8th October and will be followed by a dinner and the annual general meeting. Sir Harold Bishop, the president of the A.S.E.E., will present the trophies.

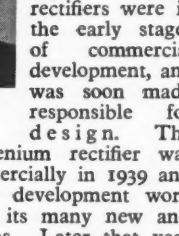
Mr. D. Ashby, A.C.G.I., B.Sc.(Eng.), D.I.C., M.I.E.E., A.M.I.Mech.E., who writes in this issue (page 587) on "Semi-Conductor Rectifiers," was educated at Dulwich College and the City and Guilds (Engineering) College. He joined Westinghouse Brake & Signal Co., Ltd., in 1928, when copper oxide rectifiers were in the early stages of commercial development, and was soon made responsible for design. The "Westalite" selenium rectifier was introduced commercially in 1939 and a great deal of development work was involved in its many new and larger applications. Later that year the company transferred the Engineering Departments and others to Chippenham where Mr. Ashby remained until 1951 when the administrational organisation of the company was changed and he was appointed assistant divisional manager of the Rectifier Division, responsible for the commercial as well as the technical aspects of the rectifier market.



Mr. D. Ashby

Mr. Ashby has travelled extensively for his company and has lectured widely on the subject of rectifiers.

Mr. W. P. B. Grey has been appointed sales manager of the southern area of the Stella Lamp Co., Ltd. Mr. Grey was formerly employed in the plastics industry and joined the Stella Company in 1953 as a London representative. He was made London sales supervisor in 1954 and southern area sales supervisor of the company in 1956.



Mr. W. P. B. Grey

Mr. W. J. Dimmock, general works manager of Hoover, Ltd., and a director of Hoover (Washing Machines), Ltd., has just completed twenty-five years' service with his company. He was presented with his long-service badge and a gold watch to mark the occasion by Mr. S. Roberts, managing director, at a dinner of the company's Quarter Century Club at the Savoy Hotel, London, on 26th September. Other members who have completed twenty-five years and who received presentations were Mr. M. G. Lane, production manager, Hoover (Washing Machines), Ltd., Merthyr Tydfil; Mr. E. J. Lane, area manager, Swansea district; Mr. A. S. Morris, foreman, Merthyr Tydfil factory; and Mr. W. H. Gregory, showroom manager, Cardiff.

The first meeting of the autumn session of the **West Riding Electrical Industry's Luncheon Club** was held on 26th September at the Griffin Hotel, Leeds, when over fifty members and guests were present. Mr. I. Appleyard, the well-known motorist, was the guest speaker, his subject being "Rallying and Racing."

The annual show day of the **British Thomson-Houston Co., Ltd.,** Willesden, was held on 21st September, and practically every social section contributed something to the success of the afternoon. The proceeds were in aid of the forthcoming children's Christmas party.

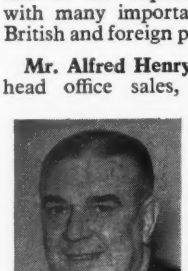
OBITUARY

Major C. E. Prince.—The death occurred on 25th September of Major Charles Edmund Prince, O.B.E., M.I.E.E., who was well known in connection with the early developments of radio telephony, especially on aircraft. Major Prince received his technical education at Faraday House and joined Marconi's Wireless Telegraph Co., Ltd., in 1907, where he became assistant to Capt. H. J. Round in radio telephony. He was one of the designers of the cavalry pack stations. After service with the Westmorland and Cumberland Yeomanry in France in 1915 he returned to begin the development of the radio telephone for aircraft. After the war he rejoined the Marconi Co. and designed an aircraft radio telephone for civil use. Later he invented an electric clock for which a private company was floated. His next appointment was with the Columbia Graphophone Co., and after a year with this company he was appointed technical managing director to the Radiovisor Parent Co., from which position he retired in 1935. Major Prince was president of the Faraday House Old Students' Association for 1932.

Lord Bennett, O.B.E., J.P., joint managing director of Joseph Lucas Industries, Ltd., died on 27th September at the age of seventy-seven. In addition to his industrial activities, Lord Bennett was prominent in the political sphere and as Mr. Peter Bennett he became Parliamentary Unionist member for the Edgbaston Division of Birmingham in 1940 and was Parliamentary Secretary to the Ministry of Labour and National Service from 1951 to 1952. He was created a knight in 1941 and was raised to the peerage in 1953. During the war he was Director-General of Tanks and Transport, Ministry of Supply (1939-40), and of the Emergency Services Organisation, Ministry of Aircraft Production. He was a past-president of the Federation of British Industries and of the Midland Regional Council, and was a past-chairman of the British Productivity Council.

Mr. G. L. Smith, a switchgear engineer with the British Thomson-Houston Co., Ltd., at Willesden, has died. He had been employed by the company since 1926, commencing as a drawing office apprentice. After service as a section engineer, he took charge, in 1945, of the newly formed protective gear and diagram section and in this capacity was connected with many important installations in British and foreign power stations.

Mr. Alfred Henry Goude, manager, head office sales, A.E.I. Lamp & Lighting Co., Ltd., died suddenly on 26th September at his home in Barons Keep, West Kensington, at the age of fifty-five. Mr. Goude was well known in the electrical industry and was a member of the Association of Public Lighting Engineers and the Illuminating Engineering Society. He joined the B.T.H. Co. in 1919 and since 1940 had held the successive posts of manager in charge of lamp and lighting sales at Plymouth and Birmingham before joining the head office staff of the company.



The late Mr. A. H. Goude

WILLS

Mr. H. C. Pierson, late director of the Metropolitan-Vickers Electrical Co., Ltd., and of other companies, who died on 26th March last, left £56,134 gross (£55,665 net).

Mr. W. E. Oughton, for thirty years a director of Baker and Hyman, Ltd., electric lighting engineers, who died on 14th April last, left £20,730 gross (£20,344 net).

Electrical Industries Ball

The Electrical Industries Ball, which is organised in aid of the Electrical Industries Benevolent Association and is one of the largest social functions of the electrical year, will be held on Friday, 8th November next, in the Great Room of Grosvenor House, London. It will start at 7 p.m. for dinner at 7.30 p.m. and continue until 2 a.m. Guests will be received by Mr. J. S. Pickles, president of the E.I.B.A., and dancing will be to Sidney Phillips' Orchestra. There will be an entertainment at midnight and many attractive prizes.

Application for tickets, three guineas each (including dinner), and table reservations should be made to the Electrical Industries Benevolent Association, 10, Buckingham Palace Gardens, London, S.W.1.

THERMIONIC VALVES

INAUGURAL ADDRESS OF THE NEW I.E.E. PRESIDENT

IN his presidential address at the first London meeting of the 1957-58 session of the Institution of Electrical Engineers last evening, Mr. T. E. Goldup, C.B.E., dealt mainly with thermionic valves particularly with regard to some aspects unfamiliar to those who do not work in the valve field. This he did under such main headings as "Background," "Foreground," "The Changing Scene," "Education and Training" and "Beyond the Horizon."

Under the first heading he traced historically the development from the days of "hard" and "soft" valves to the technological achievements of to-day, saying that by this consortium of efforts the design, manufacturing and application problems had been tackled with highly satisfactory results.

Under "Foreground" the president described some production processes, giving some idea of the materials from which valves were made, of their component parts and how they were assembled. Taking as an example the indirectly heated h.f. pentode the president explained that the heater fitted inside the cathode was made of tungsten wire 70 microns in diameter and drawn to an accuracy of $\pm 0{\cdot}7$ micron; its operating current was 300 mA and it worked at 1,200 deg C.

The molybdenum wire used for the grids had a tolerance of $\pm 1\frac{1}{2}$ per cent on diameter and the grid pitch tolerance was ± 1 micron. Research and development had their special appeal, said Mr. Goldup, and were a distinctive and satisfying element in the achievement of results which thrived on differences of approach to the solution of problems. The same was equally true of plant design and development, and as a stage in the chain of events leading to a manufactured article, their importance was paramount for they were prime factors in the economics of production.

As a reminder of the magnitude of the relatively new valve industry the president said that in 1956 the turnover of the British valve industry was £25 million and that it produced 64 million valves of all types and over two million cathode-ray tubes. He estimated that the total turnover for the whole of the electronics industry for the same year was £300 million and that by 1960 the world production of valves and transistors would possibly reach a total of 1,000 million.

The Changing Scene

Change had been the essence of valve development from the time of Fleming's early work, said the president, and he referred particularly to microwave valves, special quality valves and semi-conductors, and said that evidence of the importance of these was given by the fact that during the period 1947 to 1956 over a hundred articles were published on valve reliability and hundreds on transistors, and that early in 1958 the I.E.E. would hold for several days an international conference on microwave valves. He chose the three equipments mentioned because of the interest displayed in them by the Government.

A requirement of some importance in connection with microwave valve development was the availability of cathodes having extremely high emission current-densities and a good deal of work had been directed towards the solution of this problem, with the result that some novel forms of cathode had appeared, one example being the dispenser type pioneered by Lemmens in which the emissive materials percolated to the surface of a tungsten body when the cathode was heated.

Continuing his survey Mr. Goldup said that the magnetron had made possible many new advances in conventional radar systems; in the past the amplifier klystron had received little attention because the magnetron produced radio-frequency powers with greater electronic efficiency and in return for far less development effort. Now, however, the situation was changing with the introduction of phase-coherent radar, where the reflected pulse from a target was compared in phase with that which was transmitted, the resulting beat frequency being a measure of the target velocity; there were many different variants of the phase-coherent radar system, an important common factor being the need for improved microwave amplifying valves, with the result that in this field work was being directed towards larger powers, higher efficiencies and increased bandwidths; the travelling-wave tube was a most significant war-time invention, first conceived by Kompfner while working for the Admiralty.

Mr. T. E. Goldup

During the period between the two world wars the improvements in valve quality, performance and reliability resulted largely from the demands of the broadcast receiver manufacturers, and fruitful collaboration between them and the valve designers determined to quite a considerable extent the direction and scope of valve development. Such valves, however, were not primarily intended to withstand the shock and vibration associated with these new applications so that there arose a need for a series of valves whose characteristics would not be impaired, nor their life shortened, by these more arduous conditions.

Semi-Conductors

In dealing with semi-conductors the president said that because the transistor was an amplifying device it had a very wide range of applications in the electronics field. It was extremely small and required very little power to operate it, and for these reasons it was destined to have a profound influence on the design, for example, of computers, of Post Office equipment such as repeaters and exchangers and of Service equipments of every kind for use on land, sea and in the air.

The change between two possible energy states in molecules could be used for microwave oscillation or amplification, the interaction between a microwave system and the substance falling from a higher to a lower energy state, thus enabling power to be extracted. One class of amplifier of this kind used semi-conductors and provided *m*icrowave *a*mplification by *s*timulated *e*lectro-magnetic *r*adiation, from which was derived its abbreviated name of "Maser." This device could operate only at low power levels and theoretically its efficiency and bandwidth were not great. However, useful gain could be obtained and at the extremely low temperature at which

it had to be operated its signal/noise ratio was extremely high.

The president stressed that automation was no new thing, and the reason why it had received so much attention in recent years was that whereas formerly we made machines which could assist our physical efforts, we were now, largely through the application of electronics, able to make machines which could augment our mental efforts. We could give machines "electronic eyes and ears" and these sensing elements could feed back the information they received so that any departure from the required result could be corrected.

Within a volume the size of our heads we each had a brain weighing some 3 lb and consisting of some 10,000 million individual cells, which was about 13 times the world production of valves in 1956. If it were possible to construct a machine able to perform the same functions as the human brain it would inevitably have to be largely electronic, and if we brought together all the necessary component parts and could then in some miraculous way solve the vast problem of connecting them together, we should still be faced with the fact that even with the most reliable modern components several hundred would be faulty at any given instant.

In dealing with low-temperature devices, Mr. Goldup said there were two main developments, the "Maser" and the "Cryotron." The latter was a switching device which consisted of a straight wire with a second wire coiled round it, both immersed in liquid helium, and therefore having effectively zero electrical resistance; but the resistance of the straight wire was restored when a sufficiently strong magnetic field was produced by current in the coiled wire.

Mr. Goldup surveyed broadly the question of education and training, saying that the importance of the individual in this respect needed emphasis, particularly in these days of mechanisation, such as the development of automatic control techniques, data processing and many other labour-saving devices, for there was a danger of giving too much prominence to those things in the mistaken belief that man-power in consequence became less important. The contrary was true, however, for history showed that in the long run increased mechanisation had not led to increased unemployment.

After references to the Press, in which he expressed the opinion that the public required to be still better informed on scientific achievements and that there was a great deal more to be done in educating them to a deeper appreciation of the significance of members' work as engineers, the president concluded with a glimpse "beyond the horizon" in which he left the thought that the rôle of I.E.E. members was as leaders who accepted the responsibility of guiding opinion on the implications of scientific engineering advances so that those advances could assist the lot of mankind rather than the reverse.

B.S.I. Annual Meeting

SIR HERBERT MANZONI, city engineer of Birmingham, was re-elected president of the British Standards Institution at the annual general meeting held in London on 24th September. The vice-president, Mr. John Ryan, of the Metal Box Co., Ltd., was also re-elected.

In presenting the Institution's annual report, details of which were given in our issue of 13th September, Sir Herbert looked back over what he termed a record year. The number of publications sold had passed the million mark for the first time and both committee meetings and subscribing members had been more numerous. The general staff was, however, less than five years ago.

Looking ahead, Sir Herbert said that he thought that the B.S.I. should now turn increasingly to the pursuit of the practical advantages which flowed from the application of standardisation. During the past year some thirty meetings had been held at which invited audiences at management level had discussed the benefits of the "three S's"—standardisation, simplification and specialisation. A start had also been made, with the support of the Ministry of Education and certain technical colleges, with training courses for industrial standards officers.

In connection with the proposed setting up of the European Free Trade Area, Sir Herbert announced that the B.S.I.'s Export Panel had approved a proposal for an informal meeting of European standards organisations to be held shortly. Next year the B.S.I. would be the host when the International Organisation for Standardisation's General Assembly meets at Harrogate.

Mr. C. E. Strong (Standard Telephones & Cables, Ltd.) and Mr. G. A. Whipple (Hilger & Watts, Ltd.) were among those elected to represent the Engineering Division of the Institution's General Council. Mr. Forbes Jackson was elected to represent the Codes of Practice Division.

Post Office Engineering Research

WHEN an "open day" was held at the Dollis Hill Engineering Research Station of the General Post Office in London last week we had an opportunity to see something of the work which is being conducted there in an effort to improve British communications. Probably the most notable event in electrical communication since the last open day at Dollis Hill, three years ago, has been the completion of the first transatlantic telephone cable. The British share of this joint undertaking with Canada and the U.S.A. was largely based on the work of the Research Station, which contributed to the design of the repeaters for the Newfoundland-Nova Scotia section, supplied long-life valves, and made exhaustive studies of components and materials. The work on submarine telephony continues, and current developments of improved valves, repeaters and cables will be applied in an all-British cable, now being planned, from the U.K. to Canada. Other recent developments in long distance communication include an improved method of reception of radiotelegraph signals and electronic equipment for the automatic correction of telegraph errors.

Developments in short distance communication have been less spectacular, but they are economically important because exchange and local-line plant accounts for a large part of Post Office capital expenditure. The station has assisted in the design and testing of a new telephone set, which gives better transmission and permits lines between subscribers and exchanges to be longer and of lighter gauge. The study of electronic switching techniques for telephone exchanges continues and is now co-ordinated with the work of the main exchange manufacturers. This work has had a novel by-product in the electronic random-number indicating equipment ("ERNIE") for drawing prize-winning premium savings bonds, which makes extensive use of transistor circuits. Transistors are also being used in amplifiers for trunk telephony and in a proposed new hearing aid for the National Health Service.

The expansion of the B.B.C. and I.T.A. television services, and the consequent growth of the Post Office television network interconnecting studios, and transmitters have maintained interest in the problems of waveform transmission by cable and microwave radio. The B.B.C. television service to the Isle of Wight is carried by a microwave link designed at the station, and another link using similar equipment carries multi-channel telephony 55 miles across the Moray Firth. New microwave intermediate frequency and basebend test equipment has been developed for this work.

Other developments include a rolling mill for ultra-thin alloy strip and a single-position letter-sorting machine, twenty of which have been ordered after successful field trials. Quartz-crystal frequency-standard equipment has been produced for Government laboratories or observatories in nine countries, including the U.S.A.

LETTERS TO THE EDITOR

Letters should bear the writers' names and addresses, not necessarily for publication. Responsibility cannot be accepted for the opinions expressed by correspondents.

Professional Engineers' Status

I HAVE been abroad on holiday and have only now found time to look at the contents of back numbers of the technical Press including the *Electrical Review's* recent leading article on professional engineers' status. As you say, the need to enhance this status in the public eye is still great and anything that the Engineers' Guild can do towards that end will be welcomed by us all.

But in the matter of salaries it does seem a pity that the Guild should go on talking as if no efforts had ever been made at all by anybody until they came along. The Electrical Power Engineers' Association, for instance, has a membership over three times that of the Guild and, as you know, we have been in existence since the end of the first world war. Our membership extends from the student trainee to the top technical managerial executive; our salary range stretches from over £600 per annum at the bottom of the technical staff schedule to nearly £4,000 per annum at the upper limit of the managerial schedule. The vigorous E.P.E.A. campaign of this year brought about marked improvements in salaries and differentials for all technical staff and our suggestions for more realistic gradings are at the moment in front of the Electricity Boards.

Also, in evidence to the Herbert Committee we put strong emphasis on the desirability of engineers occupying the leading managerial posts in the electricity supply industry; throughout our history we have vigorously resisted the undue elevation of the administrator, pure, if not always so simple.

I mention these short points, not in self-praise or in disparagement of the activity of others, but in order that it should not be thought that the only collective effort made by professional engineers to look after themselves and their interests is that represented by the small membership of the Engineers' Guild.

London, S.W.1.

A. M. F. PALMER, A.M.I.E.E., M.Inst.F., M.P.,
Electrical Power Engineers' Association.

Tariff Implications

IT has long been known that there is an inverse relationship between diversity factor and individual load factor, or—in other words—a direct relationship between coincidence factor and load factor. The questions are (a) "What?" and (b) "Why?" Mr. Schiller and the American authority whom he quotes in his article in the *Electrical Review* of 27th September are chiefly interested in (a). Their motto would appear to be "Facts, not theories." That they are in very close agreement as to the facts is clearly shown in Fig. 1 of Mr. Schiller's article. Up to about 18 per cent load factor the coincidence factor is almost directly proportional. The curve then bends sharply over and becomes almost level from 35 to 70 per cent load factor, before bending up to reach (as it must) unity at 100 per cent load factor. The question still remains—why does it behave in this extraordinary manner?

The reason might not have eluded these two authorities had not both of them insisted on regarding load factor (annual or monthly) as a simple entity—a thing in itself—whereas in fact it is a highly composite and amorphous quantity. A load factor of a given value for a single-shift factory has entirely different load characteristics from the same load factor for a three-shift factory and there is little point in a mathematical treatment which neglects this difference.

There is no basic reason why this overall load factor should be mathematically related to the coincidence factor but there is a perfectly sound reason why the load factor *during the use period* should be so related. A group of single-shift industrial consumers all taking the bulk of their electricity during a particular time belt—say between 7 a.m. and 6 p.m.—may be expected to have coincidence factors very nearly proportional to their individual load factors. Their load factor variations then almost cancel out, and for cost allocation purposes they can each be treated as having the load factor of the group. The reason why the curve bends over at 18 per cent is that now an entirely different sort of load factor is beginning to come in, namely that of two-shift operation. In fact it might not be entirely fanciful to see in the three portions of this curve the influence respectively of single-, two- and three-shift operation.

The tariff implications of this theory cannot be stated in a letter but two of them may be briefly indicated. (a) The single-shift operator of medium size, with a load factor in the 0 to 20 per cent range hardly needs a demand charge at all and his costs can be covered by a block tariff with reasonable accuracy. (b) A two-part tariff which has been "tilted" to allow for the coincidence factor/load factor proportionality must be provided with steps so as to lessen the incidence of the tilt on higher load factors (corresponding to longer use-periods). Two- and three-shift operators cost less per unit to supply not, specifically, because they have higher load factors but because they spread their use over a wider time belt. Even if they had the same numerical load factor it would still be a better load factor.

London, N.W.6. D. J. BOLTON.

Third Transatlantic Telephone Cable

AN order for over 2,200 nautical miles of cable for a new transatlantic telephone link between Newfoundland and the Brittany peninsula in France has been placed with Submarine Cables, Ltd., by the American Telephone & Telegraph Company. The cable, which will cost more than £3 million, will be made at the Ocean Works, Erith, where more than 92 per cent of the cable required for the first transatlantic telephone system, opened in September last year, was manufactured.

The new cable will be laid in the summer of 1959, at a cost of £15 million, and the system is expected to be open for service by the end of that year. Under contracts signed between the American Telephone & Telegraph Company, the French Ministry of Posts, Telegraph and Telephones, the German Federal Ministry for Posts and Telecommunications, and the Eastern Telephone & Telegraph Company (a Canadian subsidiary of A.T. & T.), 64 per cent of the cost will be borne by the American company and the remainder by the French and German.

It has already been announced that the existing telephone cable linking Scotland and Newfoundland is to be duplicated as a joint enterprise between Cable & Wireless, Ltd., and the Canadian Oversea Telecommunications Corporation.

INDUSTRIAL NEWS

Cinema at Brussels Exhibition

A cinema for the showing of 16 mm or 35 mm industrial films of all types will be included in the British Industrial Pavilion at the Universal and International Exhibition to be held at Brussels from 17th April to 19th October next year. The cinema will seat over 200 people and may be used not only for the showing of documentary films but also for demonstrations, lectures or discussions. Further details can be obtained from Mr. W. Newman, British Overseas Fairs, Ltd., 21, Tothill Street, London, S.W.1.

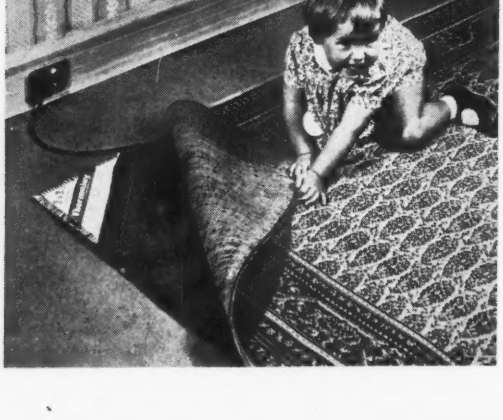
Anglo-French Radio Relay System

A project has recently been announced for a permanent cross-Channel SHF radio relay system for multi-circuit telephony and television, and the contracts for the supply and installation of the equipment, aerials and ancillary equipment for this first permanent comprehensive cross-Channel radio link have been awarded to Standard Telephones & Cables, Ltd., and Le Matériel Téléphonique, Paris, who together pioneered the original venture twenty-five years ago. The project will be a joint undertaking of the British Post Office and its counterpart, the French P.T.T.

Electrically Heated Carpets

In our last issue we referred to an electrically heated carpet underfelt which has been developed by E. Illingworth & Co. (Bradford), Ltd., an associate company of John Crossley & Sons, Ltd., and which is being marketed by Thermalay, Ltd. The carpet is being shown at the "Comfort Heating" Exhibition organised by the Merseyside and North Wales Electricity Board now in progress at its Industrial Development Centre, 83, Paradise Street, Liverpool, 1. One of the salient points of this electrically heated carpet is its safety, particularly where children are concerned, and this is emphasised in the accompanying picture.

The "Thermalay" electrically heated underfelt



Overseas Trade Map

Help for United Kingdom traders in overseas markets is the keynote of a wall map of the world which the Board of Trade is issuing to exporters and manufacturers. The map, titled "Information for the British Exporter," measures 40in by 30in and pinpoints every overseas territory where a commercial representative of the Government is normally stationed ready to help any United Kingdom trader to increase his exports. Coloured according to currency areas, the map gives comparative world times, £ equivalents and figures of recent two-way trade between principal markets and the United Kingdom together with other information of value to the exporter. Distribution of the map, which is designed to publicise the Government's services to overseas traders, will be made by the Board's regional offices and will be limited to exporters and potential exporters.

Bruce Peebles Extension

A new Electronics Department established by Bruce Peebles & Co., Ltd., at 37, Inverleith Street, Edinburgh, was formally opened on 25th September by Mr. Thomas Johnston, chairman of the North of Scotland Hydro-Electric Board. Presiding at the opening ceremony, Mr. W. B. Laing, managing director of Bruce Peebles, said it was inevitable that the company should enter the field of electronics. In automation, nuclear engineering, and the operation of the large generators and transformers which it manufactured, electronics had an increasingly important part to play, particularly in controls and instrumentation. He appealed for more Atomic Energy Authority work to be placed in Scotland and said his company had a service available to industry in general of which it hoped full advantage would be taken. He acknowledged the assistance the company had received from Mr. W. S. Robertson, secretary of the Scottish Council (Development and Industry), and from Ferranti, Ltd., in the setting up of the new Department. The guests included Mr. J. Henderson, chief engineer, South of Scotland Electricity Board; Lord Provost Ian A. Johnston-Gilbert; Mr. J. Hoy, M.P.; Dr. H. Nisbet, Principal, Heriot-Watt College, Edinburgh; Mr. J. N. Toothill, managing director of Ferranti's factory at Crewe Toll, Edinburgh; Mr. W. S. Robertson; and Mr. S. Smith, chairman, Scottish Gas Board.

Fluorescent Lamp Price Reduction

Siemens Edison Swan, Ltd., announces that the retail price of its 8ft 125 W natural and warm white fluorescent lamps has been reduced from 25s to 20s.

Prices of Materials

In the accompanying table we give the basis prices of the more important materials used in the electrical industry. The figures given are the selling prices and are those quoted on Tuesday last.

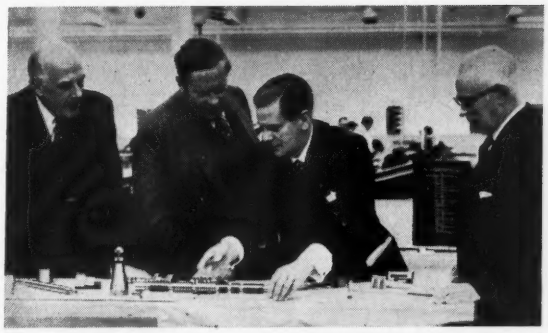
ALUMINIUM ingots	ton £197 0s 0d
COPPER, H.C. Electro	ton £190 15s 0d
Fire Refined 99·70%	ton £189 0s 0d
Fire Refined 99·50%	ton £188 0s 0d
COPPER Tubes ..	lb 1s 10½d
Sheet	ton £216 10s 0d
H.C. wire and strip ..	ton £243 15s 0d
LEAD, English ..	ton £88 17s 6d
Foreign	ton £87 0s 0d
MERCURY	flask £85 0s 0d
TIN, block (English) ..	ton £741 0s 0d
ZINC, G.O.B. Foreign	ton £70 17s 6d
Electrolytic	ton —
BRASS Tubes (solid drawn)	lb 1s 6¼d
Sheet	ton —
Wire	lb 2s 4½d
PHOSPHOR BRONZE Wire	lb 3s 7⅝d
PLATINUM	oz £31 0s 0d
RUBBER, No. 1 R.S.S. spot	lb 25⅛d—25½d

Courses in Electrical Housecraft

Each autumn short courses in practical electrical housecraft are given by the Electrical Association for Women. They include instruction in replacing fuses and re-wiring plugs. This year they will be held at 6.30 p.m. on the following dates at the Association's headquarters, 25, Foubert's Place, London, W.1:—16th, 23rd and 30th October; 5th, 12th and 19th November; 6th, 13th and 20th November; and 7th, 14th and 21st January. The fee for each course of three lessons is 5s.

Apprentice Training School

Extensions to the Apprentice Training School at the Trafford Park Works of the Metropolitan-Vickers Electrical Co., Ltd., were officially opened by Sir Edward Boyle, M.P., Parliamentary Secretary to the Ministry of Education, last week. Sir Edward was received by Lord Chandos, chairman of Metropolitan-Vickers and also of the Associated Electrical Industries Group. In his speech before unveiling a commemorative tablet, Sir Edward stressed the great need for training



Sir Edward Boyle examining the work of the Metropolitan-Vickers Apprentice Training School. Left to right: Lord Chandos, Sir Edward Boyle, Mr. R. F. Marshall (manager, M.-V. Education Department) and Dr. C. Dannatt (managing director)

for engineers at all levels and recalled the part that Metropolitan-Vickers had played in the past in the provision of facilities for the training of engineers.

The School, which was established in 1951, has accommodation for 500 boys and girls and caters for the initial training of all the company's apprentices, at present some 2,500. It comprises a large workshop area, drawing office, classrooms, canteen, libraries, and reading and recreation rooms, together with a sports ground covering 12 acres. Apprentice supervisors and instructors are responsible for the training programmes, and special efforts are made to create at this early stage the good personal relationships so desirable in an organisation employing 26,000 people.

Furnaces for Russia

Machinoimport, the Russian trading organisation in Moscow, has recently ordered two furnaces and an atmosphere generator from Birlec, Ltd. The first of these units is a standard Birlec mesh belt conveyor furnace for normalising and copper brazing steel parts. Rated at 120 kW, this furnace will have a maximum operating temperature of 1,150 deg C. It will have a belt width of 24in and an opening height of 8in and will be capable of normalising approximately 800 lb of work per hour. The atmosphere for this furnace will be provided by a Birlec No. 1 type "Exothermic" atmosphere generator with a nominal output capacity of 3,000 c.f.h., arranged for operation from town's gas.

The second furnace is an RS 24/12/8 horizontal, single ended batch furnace for general heat treatment and scale free hardening. This unit, rated at 20 kW, has internal dimensions of 24in length, 12in width and 8in height, and has a maximum operating temperature of 1,050 deg C.

Hurseal Conference

Executives and area managers of the Hurseal Group met in London on 13th September for a two-day conference. Among the points discussed were the best ways of marketing Hurseal electric safety radiators. The local managers were told of future advertising plans and of various new electrical products that would shortly be introduced, including the low column oil-filled radiator and the miniature panel radiator. A number of British and American films on management and customer relations were shown.

In his summing up, Mr. A. C. Hazel (managing director) paid tribute to the work of the area managers.

Chefs Demonstrate on Electric Range

At the Food, Cookery and Catering Trades Exhibition held in the City Hall, Manchester, from 10th to 21st September, master chefs from leading hotels in the North of England gave demonstrations on an electric range. Arrangements for the series were made by the North Western Electricity Board in conjunction with the organisers. The cooking was done on the new "Creda Chef" range, which has a solid boiling top specially designed to meet the requirements of chefs. Demonstrations on the range were also given by students of both the Hotel and Catering Department of Manchester Domestic and Trades College and of the Army Cookery Instruction Centre at Lichfield.

Wholesalers Merge

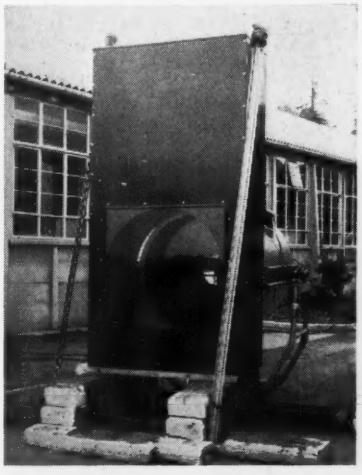
Two electrical wholesalers, G. Casperson, Ltd., and Sellers of Leeds, Ltd., have combined forces and they are now trading under the name of Caselco, Ltd. The company is continuing to operate from the same premises as the former companies at 46, Park Square, Leeds, 1, with the same staff and management as before. Apart from having taken over the electrical wholesaling activities, Caselco, Ltd., is continuing as agent for the Yorkshire area for the Denis Ferranti Co., Ltd., and for Allspeeds, Ltd.

Floodlighting Niagara Falls

A contract to floodlight Niagara Falls with a new British-designed colour floodlighting system to replace the existing one has been awarded to the Amalgamated Electric Corporation, Ltd., Canadian subsidiary of the General Electric Co., Ltd. The contract, awarded by the Niagara Falls Illumination Board, is valued at $153,000 (about £55,000). The floodlights will be mounted on the Rotunda in the Queen Victoria Park, which is the hub of Niagara Parks commanding an unequalled view of the Niagara Falls. Ten projectors will illuminate the 2,600ft wide Canadian Horseshoe Falls 1,700ft away; three more will be directed towards the Upper Rapids, two will light the rock face at the base of Goat Island joining the two falls, and five will illuminate the American Falls 3,000ft away. Although they will consume no more power than the 24 floodlights which they will replace, the brightness provided by the new projectors will be at least four times as great.

The floodlighting system, which was devised by G.E.C. lighting engineers working in conjunction with the company's research laboratories, Wembley, was explained to representatives of the Niagara Parks Commission in Canada on a tape recording made at the G.E.C. laboratories and flown to Canada. Later, representatives of the Niagara Parks Commission attended a large scale working demonstration of a specially designed G.E.C. prototype projector in a field at Stanmore, Middlesex. A distant hill chosen for its topographical similarity to the falls at Niagara was camouflaged and smoke and water used to represent Niagara Falls. Smoke bombs were used and cascades of water were supplied by hoses of fire brigades from the G.E.C. factories at Hammersmith and Wembley and the company's Research Laboratories at Stanmore. "Walkie-talkie" was used to control the demonstration, the recorded sounds of Niagara were played as a background, and a running commentary was broadcast.

Twenty specially-designed weatherproofed high-current density carbon-arc projectors incorporating remotely-controlled automatic colour-changing devices and wide-beam arrangements will be used to provide a large range of dramatic lighting effects. The projectors, which will be supplied under



A prototype of the G.E.C. floodlights specially designed for the floodlighting of Niagara Falls

sub-contract by Savage & Parsons, Ltd., of Watford, will be equipped with a forced ventilation system which has been evolved to operate under the varying climatic conditions experienced at Niagara.

Works Visit

A party of South African Government officials visited Marconi's Wireless Telegraph Co., Ltd., at Chelmsford on 25th September. The visit was arranged in conjunction with the Board of Trade. The party included Dr. the Hon. A. J. R. Van Rhijn (S. African Minister of Economic Affairs and Mines), Mr. D. De Waal Meyer (Permanent Secretary for Commerce and Industry), Mr. W. A. Horrocks (Senior Trade Commissioner for South Africa), Mr. J. Venter (Private Secretary to the Minister) and Mr. T. Lattimer (Board of Trade). In the course of their visit the guests were conducted by Mr. F. N. Sutherland, general manager of Marconi's, on a tour of the works where they saw the latest electronic equipments under construction and test.

Atlas Lighting Convention

Following upon the success of a series of lighting conventions held for the first time last year, Atlas Lighting, Ltd., have again arranged for similar conventions to be held throughout the country during this month.

The first of this new series was staged at the St. Pancras Town Hall Assembly Rooms on Thursday evening last week and among those in attendance were architects, designers, consulting engineers and Electricity Board officials. The programme included a showing of the company's new film "Fitting Conclusions" which dealt with the manufacture and application of Atlas fluorescent lighting fittings.

A talk entitled the "Electronic Testing of Atlas Lamps" was given by Dr. H. H. Ballin followed by an entertaining tableau, "A Day in the Life of an Atlas Showroom," and the opportunity was taken to present the many new lighting fittings from the Atlas range for 1957-58.

Similar meetings will take place at Sutton Coldfield (7th October); Bristol (10th October); Manchester (21st October); Glasgow (25th October); Whitley Bay (28th October) and Harrogate (30th October). A second convention will also be held at the St. Pancras Assembly Rooms on Thursday, 17th October.

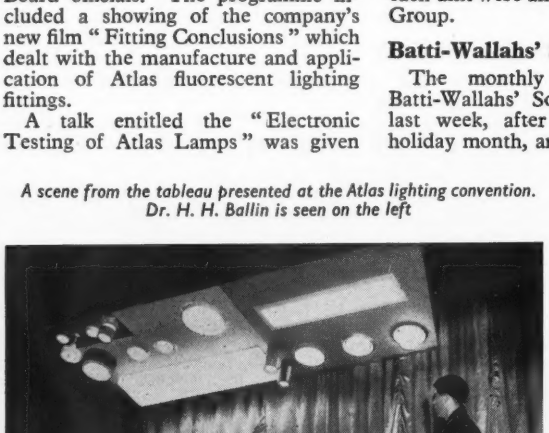
Distillation Plant for Bahamas

The Crown Agents for Overseas Governments and Administrations have placed an order with G. & J. Weir, Ltd., Glasgow, for sea-water evaporating and distilling plant for the Clifton Pier power station of the Bahamas Electricity Corporation. The installation embodies two independent units, each of which produces more than half a million gallons of fresh water daily for domestic use, and a small quantity for supplying the power station boilers with de-aerated feed water. This order, worth more than £500,000, was obtained in international competition through the consultants, Preece, Rider & Cardew. A feature of the equipment is that it will be made largely of "Colclad" stainless steel in a new design, and fabricated at the site. Each plant will have a main structure 32ft high, with internal compartments to form an eight-effect evaporating plant of the submerged tube type. The necessary distillers, condensers, preheaters and pumps for each unit were all supplied by the Weir Group.

Batti-Wallahs' Society

The monthly luncheons of the Batti-Wallahs' Society were resumed last week, after the break for the holiday month, and Dr. L. G. Brazier, the president, was in the chair. The recent stormy weather at sea had delayed the work of the cable ship *Alert* and its captain (Capt. R. H. J. Wallis), who was to have been the guest speaker, was unable to attend. Dr. A. L. Williams, of British Insulated Callender's Cables, Ltd., however, who stepped into the breach, has been closely associated with the development of submarine power cable, and he gave an interesting account of the laying of the first h.v. submarine power cables between British Columbia and Vancouver Island which, he said, owing to its size and weight created new problems in underwater cable-laying. He described the work carried out with an experimental length of cable in this country and the actual cable-laying operations in Canada. Mr. T. C. F. Bigland (the "Mate") announced that the Society's next luncheon would be on Wednesday, 30th October.

A scene from the tableau presented at the Atlas lighting convention. Dr. H. H. Ballin is seen on the left



West German Rail Officials' Visit

A party of forty-five senior railway technical officials from Western Germany are in London this week for a tour of British Railways' lines and installations. The tour has included a visit to the works of J. Stone & Co. (Deptford), Ltd., at Deptford and Crawley (Sussex) to inspect train-lighting, air-conditioning, and other equipment, a conference at Manchester (London Road) for explanation of the electrification scheme and other improvements, and journeys by electric train to Sheffield for visits (arranged by the British Thomson-Houston Co., Ltd.) to the Meadow Hall Works of the Yorkshire Engine Co., Ltd., and the Attercliffe Common Works of the Metropolitan-Vickers Electrical Co., Ltd.

World Electrical Exports

Under the title "Foreign Competition in World Markets" some useful tables have been compiled by the British Engineers' Association, 32, Victoria Street, London, S.W.1. The tables present the total trade in machinery (electrical and non-electrical) and electrical goods and apparatus of the eleven leading exporting countries and analyse the markets of the world (about 90) to show the value of each supplier's contribution from 1952 to 1956.

Industrial Films

A festival, "Films in the Service of Industry," will be held at Harrogate from 8th to 12th October. Among the films to be shown will be the Brook Motors "Winding Journey," which will compete for the awards which are to be made for the best films in the festival.

Refrigerator Compressors for Canada

Lec Refrigeration, Ltd., has received an order from Canada for compressors to a value of $650,000.

Trade Announcements

Clang, Ltd., has appointed Mr. C. F. Warde, of 26, Tennis Road, Hove, 3, as area representative in Southern and South Western England and South Wales.

Production has commenced in Britain of the range of Lagonda tube cleaning equipment, including all types of cutter heads and boring tools. This

announcement is the outcome of recent negotiations between the Elliott Company, a division of the Carrier Corporation, of Springfield, Ohio, U.S.A., manufacturers of the Lagonda equipment, and the **Consolidated Pneumatic Tool Co., Ltd.,** 232, Dawes Road, London, S.W.6, resulting in an agreement between the two companies which provides for the manufacture in Britain of every type of Lagonda tube cleaner. Consolidated Pneumatic will also provide complete sales and service facilities for Lagonda equipment throughout the Sterling Area.

G.W.B. Furnaces, Ltd., Dudley, has opened new London offices at Sicilian House, 7, Sicilian Avenue, London, W.C.1 (telephone: Chancery 6727/8). The sales engineers are: Electric furnaces, Mr. D. H. Leage; "Power-master" boilers, Mr. M. A. Stary and Mr. Brixey (service); and control gear, Mr. K. Trudgen.

Mr. A. S. Rake has joined the **British Central Electrical Co., Ltd.,** as technical representative attached to its depot at Briticent House, Addlewell Lane, Yeovil. His address is at 131, Ilchester Road, Yeovil (telephone: Yeovil 1596). Mr. K. J. Auger has also joined the company and will be responsible for looking after the day to day operation of its depot at Yeovil (telephone: Yeovil 2596).

Nettle Accessories, Ltd., Manchester, announces two changes in its outside sales staff. The North Western area including North Wales is now covered by Mr. D. Carney, who was previously representative in the area covered by the Southern Electricity Board. The area vacated by Mr. Carney is being taken over by Mr. M. Freeman.

British Insulated Callender's Cables, Ltd., announces that the telephone number of its depot at Camden Street, Derby, has been changed to Derby 41421/2.

Giles (Electrical Engineers), Ltd., has opened a new showroom at 389, Uxbridge Road, Hatch End, Middx., for the sale of radio, television, domestic appliances, etc.

The telephone telex number of the **Spencer Wire Co., Ltd.,** is telex 55-160.

As from 7th October the address of the Bristol depot of the **Simplex Electric Co., Ltd.,** will be 104-107, Redcliff Street, Bristol, 1 (telephone: Bristol 27271).

In the Courts

Fines for False Trade Description

After a trial lasting eight days E.M.P. Electric, Ltd., of Tottenham, were found guilty at the Old Bailey on Friday on four counts of applying a false trade description to 600 A, 400 A, 250 A and 200 A fuse links between 31st December, 1955, and 1st May, 1956, by describing them as A.S.T.A. certified, but they were found not guilty of falsely applying "A.C.5" to the 600 A and 400 A fuse links. Mr. Kurt Dannenberg, chartered electrical engineer and a director of E.M.P. Electric, Ltd., was found guilty of causing the company to apply the false description.

E.M.P. Electric, Ltd., were fined £1,000 and ordered to pay a sum not exceeding £200 towards the costs of the prosecution. Mr. Dannenberg was fined £500 with the alternative of 12 months' imprisonment. Judge Aarvold allowed 14 days for paying the fines.

Passing sentence, his lordship told Mr. Dannenberg, "I accept the view that at all times you were confident that you were making and selling a fuse link that could operate up to the standard of A.C.5 and I also accept that it has not been proved in this court that any of your links failed in that duty. I also accept that you take a pride in your product, in your own ability to produce a good product, but I am not at all impressed by your commercial tactics because it seems to me you quite deliberately worked out a formula whereby you thought you could apply A.S.T.A. certified to your products in the cheapest possible way, even if that meant forsaking accuracy and straying into falsity. You were no doubt confident that the quality of your goods would justify your action and save you further trouble. Now you find that the cheap and false way is by no means inexpensive. In all the circumstances of this case it would be right if I imposed a financial penalty on you and your company. It is a penalty which I have insufficient information to judge whether or not it is severe enough. I only hope you will not take it as an encouragement to employ similar tactics in the future."

The prosecution had alleged that E.M.P. Electric, Ltd., claimed that their fuse links had been certified by the Association of Short-circuit Testing Authorities as conforming to the relevant British Standard specification when in fact they had not. In May, 1956, as a result of information which they had received, the Board of Trade sent an inspector to the offices of G. P. Dennis, Ltd., switchgear manufacturers, of Speke, Liverpool, to collect samples of fuse links supplied by E.M.P. Electric. These were subsequently tested and the 600 A, the 400 A and the 250 A links failed to conform to the test. When the 600 A fuse was put to the test it was destroyed and the fuse barrel shattered. Although the 200 A fuse link did not positively fail, the prosecution submitted it was wrong to say it was A.S.T.A. certified. At the time of the alleged offences E.M.P. Electric held certificates only in relation to 500 A and 300 A fuses.

Mr. Dannenberg, in evidence, claimed that the failure of the fuse links when tested by Mr. Leader at Henley's test station, Gravesend, was due to the mechanical effect of electromagnetic forces and was not due to any electrical failure. The mounting used by Mr. Leader was a makeshift affair and it was unfair to test the fuses on such a mounting.

Mr. Dannenberg said millions of his fuse links were in use in various parts of the world and he had not received a single complaint over a number of years. He claimed that the company's fuse links were A.S.T.A. tested in 1949. Although modifications were subsequently made he said the basic design was the same and that was all that an A.S.T.A. certificate meant. He admitted, however, that the performance of the fuse links complained about was different from the fuse links which were tested by A.S.T.A.

Summing up, Judge Aarvold said the jury might think the whole idea of having standards such as A.S.T.A. was not to leave anything to the discretion of various manufacturers whether they were members of the Association or not. The object was to set a particular standard which everyone would understand. It was not disputed in this case that the fuses had been altered.

Mr. M. Finer (defending) said this was the class of case where an offence had been committed in moral innocence without causing any harm in actual fact and in circumstances where it was at least reasonable for the defendants to take the view that there was more than one standard which might be applied to this matter. Counsel submitted that in a sense this had been a test case for A.S.T.A. and that many prosecution witnesses, under cross-examination, had admitted that there had been haziness and doubt and that nobody really knew what the position was in this matter. "I do not want to say that this is a technical offence but it is an offence which was, as it were, honestly committed without any intention to cheat and without anyone having been cheated," counsel concluded.

OVERSEAS ELECTRICAL TRADE

EXPORTS AT SATISFACTORY LEVEL IN AUGUST

WITH the incidence of the annual holidays and the Bank Holiday week-end, August is usually considered to be one of the lean months of the year so far as British electrical exports are concerned. The figures for August last, however, published in the Board of Trade returns, show that they were little less than for some of the earlier months of the year; the figures for the preceding month were above the average, due to exceptionally large shipments of submarine cable. The total value of exports in August was £18,256,523, as compared with £21,673,167 for July and £17,943,300 for August last year.

In the generating sets, motors, etc., group, exports were only slightly below the July figure, and when compared with August last year, showed a rise of nearly £300,000. The value of exports of converting machinery, mercury-arc rectifiers, transformers, etc., was nearly £300,000 down on July, but over £100,000 up on the August, 1956, figure. Similarly, although exports of radio and television, etc., apparatus were below the previous month's total, they showed an improvement as compared with August last year of £200,000. Telegraph and telephone apparatus exports were also a little less than for July,

TABLE I.—ELECTRICAL EXPORTS

Class	August, 1957	Eight months ended 31st August, 1956	Eight months ended 31st August, 1957
	£	£	£
Generating sets and generators:			
Diesel-driven, up to 10 kW	146,231	1,163,334	1,202,636
Ditto, 10 to 65 kW	176,922	1,055,790	1,343,284
Ditto, 65 to 200 kW	94,978	1,126,746	973,739
Ditto, over 200 kW	268,822	2,527,796	2,526,413
Spark ignition engine driven	9,024	258,309	135,124
Steam turbine driven	59,352	610,152	347,727
Hydraulic turbine driven	—	51,786	—
Other prime mover driven	32,260	443,211	228,446
Generators, not exceeding 200 kW	145,573	989,183	1,260,063
Ditto, over 200 kW	97,905	609,937	1,008,359
Parts of generators	506,868	4,229,599	3,139,607
Motors, complete, other than railway, tramway and trolley-bus:			
Up to ½ h.p.	130,903	1,535,152	1,548,019
Over ½ but under 1 h.p.	50,729	462,364	381,615
1 h.p. to 250 h.p.	459,264	3,384,297	3,886,882
Over 250 h.p.	167,794	568,275	1,147,634
Railway, tramway and trolley-bus motors complete and parts of all motors	227,284	1,310,310	1,673,311
Motor starting and controlling gear	275,093	1,892,669	2,555,962
	2,849,002	22,218,910	23,358,821
Converting machinery	16,205	280,393	412,617
Mercury-arc rectifiers	171,585	561,129	919,521
Transformers for lighting, heating and power (incl. coils):			
Not exceeding 7,500 kVA	544,939	8,578,578	4,986,501
Over 7,500 kVA	320,152		2,121,349
Switchgear and switchboards (not telegraph or telephone), up to 200 A and 660V	398,196	2,212,315	2,816,794
Ditto, other	1,247,335	9,414,860	9,695,837
	2,698,412	21,047,275	20,952,619
Primary batteries:			
Lighting	118,817	660,328	808,097
Radio	217,474	2,000,400	2,005,326
Other	37,719	352,744	337,664
Parts (excl. carbons)	51,903	306,350	445,208
Lamps:			
Filament, exceeding 28 V*	91,395	811,003	747,079
Ditto, under 28 V*	26,256	248,020	239,911
Arc lamps and searchlights	9,069	165,819	108,422
Discharge lamps, fluorescent tubes, etc.	94,678	576,419	754,585
Radio and television, etc., apparatus:			
Thyratrons, hot cathode mercury vapour and gas-filled rectifiers (excl. mercury arc rectifiers), photo-electric cells, stabilising and cold cathode valves, magnetrons, klystrons	24,887	220,030	193,517
All other	225,371	1,989,138	2,348,144
Parts (excluding glass bulbs)	13,366	85,052	98,638
Radio and television transmitters	15,782	759,377	481,898
Commercial radio and radar equipment	1,166,008	9,523,677	10,173,159
Domestic radio receivers, mains	85,941	1,043,884	886,353
Ditto, battery	41,682	626,844	437,405
Ditto, other (incl. car)	33,232	196,728	218,048
Radiograms	45,149	283,932	246,843
Television sets	30,456	311,437	443,888
Public address equipment	91,554	691,659	755,599
Other radio and television apparatus, n.e.s.	29,486	267,849	345,633
Components and parts, n.e.s.	857,519	5,479,275	6,471,402
	2,660,433	21,478,882	23,100,527
Telegraph and telephone installations	807,522	4,956,576	5,908,078
Telephone instruments, separately consigned	158,717	1,117,681	1,299 282
Telegraph and telephone parts	766,613	5,088,690	6,467,881
Line apparatus for long distance commun.	289,522	1,688,689	1,564,130
	2,022,374	12,831,636	15,239.371

Class	August, 1957	Eight months ended 31st August, 1956	Eight months ended 31st August, 1957
	£	£	£
Cookers	43,044	638,047	505,030
Toasters	20,287	188,846	160,941
Other cooking apparatus	40,789	288,481	261,441
Parts and accessories	66,990	646,586	542,512
Space heating appliances	26,168	288,006	257,491
Water heating appliances	34,937	273,553	262,452
Other heating appliances	27,863	312,652	286,694
Parts and accessories	41,300	500,550	440,895
Irons	68,388	755,251	577,275
Arc welding equipment, a.c.	52,223	443,628	426,737
Ditto, d.c.	24,518	390,386	346,184
Resistance welding equipment	12,652	153,405	185,043
Electric furnace plant	58,650	472,898	675,707
Magnetos, ignition	8,387	216,214	194,600
Sparking plugs	102,289	1,356,365	1,281,342
Elec. appliances for aeroplanes, n.e.s.	268,346	1,713,780	2,182,764
Ditto, for motor vehicles, n.e.s.	303,512	2,872,471	2 804,267
Ditto, for cycles, n.e.s.	54,208	516,426	469,131
Signalling app. (incl. traffic signals)	155,568	521,727	971,408
Instruments, commercial	149,307	1,398,562	1,393,410
House service meters (including parts)	167,134	1,350,258	1,162,984
Electro-medical apparatus (not X-ray)	31,826	272,270	328,940
X-ray apparatus (excl. tubes and valves)	71,386	532,163	582,583
Vacuum tubes	37,237	237,983	345,895
Ceiling fans, complete	97,890	867,083	952,171
Desk fans, complete and parts of desk and ceiling fans	45,144	296,324	321,154
Vacuum cleaners	137,069	1,139,089	1,205,092
Floor polishers	68,321	601,395	680,768
Food mixers	40,577	503,912	389,629
Hair clippers and dry shavers	48,491	529,430	606,076
Other portable appliances	25,113	241,358	223,198
Parts	172,965	918,620	1,110,215
Portable elec. tools (not saws) and parts	165,299	1,693,580	1,722,626
Cables and wires:			
Telegraph and telephone, submarine	92,798	1,456,193	4,167,183
Ditto, other	933,298	6,924,565	7,860,714
Cotton, silk or art. silk insulated	28,920	438,746	300,755
Enamel, glass or asbestos insulated	65,502	805,442	745,487
Paper insulated	616,713	7,531,183	6,332,014
Rubber insulated	482,091	4,262,289	4,422,005
Thermoplastic insulated	222,119	1,108,963	1,594,374
Other	195,669	1,825,838	1,443,450
	2,637,110	24,353,319	26,865,982
Accumulators for motor vehicles	179,684	1,359,294	1,263,574
Ditto, traction	41,576	205,130	226,160
Ditto, radio and other portable	23,900	707,042	558,501
Ditto, other	27,609	486,769	253,401
Parts and accessories	100,196	720,945	684,053
Elec. porcelain, etc. (incl. insulators), n.e.s.	81,023	918,332	839,741
Insulating cloth and tape	47,287	503,131	465,936
Other insulating material	74,583	825,001	757,596
Permanent magnets	43,339	357,834	407,696
Radio, telegraph and telephone testing equipment, n.e.s.	55,374	347,539	504,920
Scientific elec. instruments (not telegraphic or telephonic):			
Time recorders and time switches, complete	8,493	116,486	92,515
Other	322,604	1,693,169	2,417,581
Electrical machinery, n.e.s.	237,639	984,478	784,182
Electrical apparatus and appliances, n.e.s.	830,696	6,395,732	7,231,860
TOTAL	18,256,523	145,803,286	155,307,983

* The figures for 1957 are not completely comparable with those for previous years.

TABLE II.—DISTRIBUTION OF EXPORTS OF ELECTRICAL MACHINERY, APPARATUS AND APPLIANCES

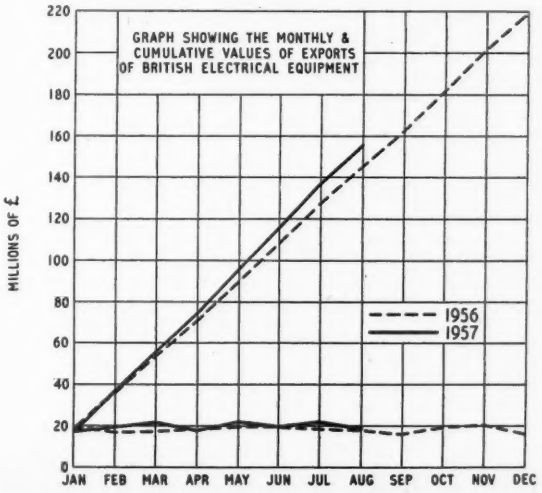
Country	August, 1957	Eight months ended 31st August, 1956	Eight months ended 31st August, 1957	Country	August, 1957	Eight months ended 31st August, 1956	Eight months ended 31st August, 1957
	£	£	£		£	£	£
Channel Islands	93,907	575,903	718,206	Western Germany	242,408	1,379,557	1,642,091
Gibraltar	18,903	277,825	148,885	Netherlands	489,899	4,937,307	5,424,806
Malta and Gozo	64,219	467,813	473,739	Belgium	236,278	2,206,499	2,508,795
Cyprus	128,893	1,078,989	1 079,114	France	311,175	2,462,879	3,074,357
Sierra Leone	27,015	205,473	280,566	Switzerland	99,266	775,977	994,270
Gold Coast	103,181	1,133,799	1,433,348	Portugal	248,735	1,332,425	1,988,741
Nigeria	296,254	2,328,656	2,210,418	Spain	255,738	2,959,206	2,830,750
Union of South Africa	1,746,964	10,593,055	12,000,883	Italy	271,967	2,178,784	2,764,467
Rhodesia and Nyasaland	550,126	4,149,896	4,114,089	Austria	39,688	293,922	307,795
Tanganyika	124,600	442,923	626,941	Yugoslavia	76,919	397,599	415,283
Kenya	220,458	1,833,653	1,977,038	Greece	66,538	1,872,488	1,024,682
Uganda	39,791	583,525	699,484	Turkey	123,216	574,007	535,509
Mauritius	55,213	189,044	280,618	Belgian Congo	51,353	223,505	373,852
Aden	50,692	387,570	389,708	Portuguese East Africa	30,723	172,462	242,816
Bahrain, Qatar and Trucial States	79,781	700,834	1,159,070	Egypt	2,154	1,553,984	18,828
Kuwait	398,860	1,000,715	2,418,345	Libya	43,830	192,997	292,117
India	1,441,707	14,321,076	15,814,921	Southern Morocco	41,640	326,749	284,777
Pakistan	220,561	2,438,460	2,194,950	Sudan	80,265	627,573	850,504
Singapore	256,745	2,401,666	2,710,931	Syria	21,727	541,740	234,324
Federation of Malaya	319,810	2,115,055	2,341,887	Lebanon	88,507	450,983	361,903
Ceylon	170,180	1,486,276	1,150,514	Israel	27,365	759,686	486,304
British North Borneo	24,942	196,249	199,538	Jordan	4,467	452,752	444,370
Sarawak	19,858	131,542	191,802	Saudi Arabia	41,142	984,824	411,013
Hong Kong	258,945	1,656,055	1,999,715	Iraq	288,967	2,622,334	2,007,746
Australia	1,753,784	15,086,019	13,584,854	Iran	349,609	1,582,644	2,854,960
New Zealand	1,055,200	7,126,730	7,744,559	Burma	144,526	982,323	763,563
Fiji	17,849	165,438	140,032	Thailand	64,522	738,929	708,745
Canada	942,101	8,654,709	8,761,671	Indonesia	33,832	434,321	429,195
Jamaica	166,139	808,173	864,536	Japan	81,798	514,563	595,057
Barbados	12,309	203,841	140,453	United States of America	698,015	6,528,674	9,767,357
Trinidad	98,271	838,913	903,249	Cuba	53,738	301,805	436,091
British Guiana	52,480	313,663	334,112	Mexico	68,941	550,782	444,951
Other Commonwealth countries	220,097	711,669	939,729	Colombia	39,435	623,926	454,655
Irish Republic	215,613	2,344,497	1,768,802	Venezuela	319,242	2,201,227	2,313,493
Soviet Union	250,432	1,886,111	1,579,340	Peru	52,746	416,269	469,900
Finland	133,780	1,206,050	1,109,198	Chile	51,838	214,280	350,125
Sweden	387,882	2,694,203	3,103,758	Brazil	88,548	1,404,507	712,826
Norway	177,172	1,717,325	1,659,590	Uruguay	17,276	82,001	160,111
Iceland	12,796	110,021	135,926	Argentine Republic	139,752	628,896	1,009,279
Denmark	113,133	1,429,392	1,511,376	Other foreign countries	527,333	2,134,584	3,071,305
Poland	10,762	190,510	350,375	TOTAL	18,256,523	145,803,286	155,307,983

but nearly £400,000 better than for August, 1956. It was not to be expected that the large shipments of submarine cable in July would be repeated in August, and the total for the latter month of £2,637,110 was nearly £2,000,000 lower than the July figure; it was, however, also over £400,000 less than the total for August, 1956.

The three principal markets for generating sets, motors, etc., were South Africa (£331,488), Australia (£330,385) and India (£258,473). In the converting machinery, mercury-arc rectifiers, etc., group, India, with purchases of £422,600 maintained her lead, but South Africa with £415,045 took the second place from Canada which imported equipment valued at £338,128.

Australia was the best customer for radio, television and radar apparatus (£225,201) and also for telegraph and telephone apparatus (£384,574).

The United States, which jumped to first place in July in the cables and wires group (because of large purchases of submarine cable), dropped back to third place in August with imports valued at £279,904, and India took the lead with £347,597, followed in second place by New Zealand with £280,314.



In Tables I and II we analyse the figures given in the electrical section of the returns. There are, however, other electrical items shown elsewhere in the returns, the figures for which are given below:—

Electrically operated washing machines, complete, not exceeding 150 lb net weight: August, £240,284; eight months, £2,232,370 (against £2,376,533); ditto, 150-250 lb: August, £75,487; eight months, £803,816 (£802,908). Parts: August, £51,453; eight months, £478,584 (£554,718).

Electric locomotives: August, £213,366; eight months, £2,823,559 (£1,572,329).

Locomotives with i.c. engines and electrical transmission: August, £263,990; eight months, £1,937,144 (£6,498,938).

Welding electrodes (excluding carbon), covered: August, £103,800; eight months, £977,323 (£900,791).

Electric conduit tubes and cased tubes: August, £59,609; eight months, £618,072 (£586,131).

Electric carbons, including parts: August, £46,412; eight months, £449,310 (£390,383).

Electric lighting fittings and lanterns, complete, with or without bulbs (excluding arc lamps, searchlights and cycle lamps): August, £194,885; eight months, £1,645,070 (£1,152,383).

Other electric lighting appliances (excluding vacuum tubes and lamp bulbs) and fittings and parts n.e.s.:— August, £209,919; eight months, £1,894,646 (£2,621,412).

Electrical Imports

There was a fall in imports of electrical goods and machinery in August, as compared with July, the total of £2,123,084, comparing with £2,355,986, but it was still considerably higher than the figure of £1,642,180 for August, 1956, and the total of £17,203,623 for the first eight months of the year compares with £15,445,448 for January-August, 1956.

Operating Results and Technical Developments

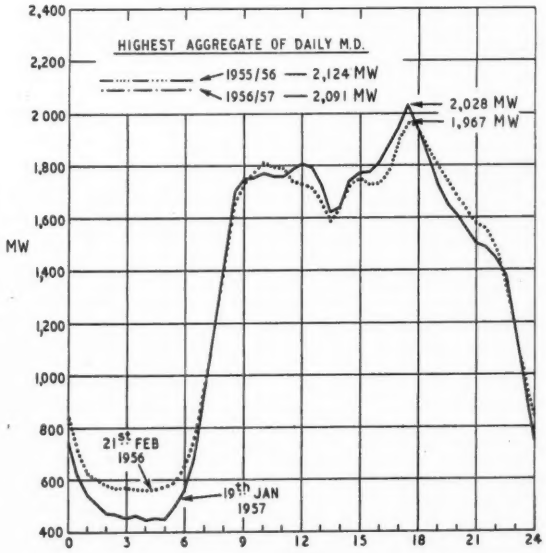
Points from the Electricity Boards' 1956-57 Reports

THE milder weather of last winter and Government action to restrict home spending tended to retard electrical expansion in 1956-57. The fact, however, that several of the Area Boards report an increase in installation work —in contrast to the reduction in showroom sales— suggests that when normal conditions return the electrical demand can be expected to rise rapidly. In particular, last year saw a notable extension of off-peak heating and this, together with the weather conditions, helped in a number of cases to improve load factors.

As will be seen from the accompanying table, the increases in simultaneous maximum demand were mostly relatively small and one Board (the North Western) reports a lower m.d. than in the previous year. In its case a special circumstance was the starting up of the Calder Hall atomic power station which also took over the supply of electricity to the Atomic Energy Authority's factory at Windscale. The majority of Boards experienced their m.d.s on 14th or 15th January, the North Eastern Board (19th December) being an exception. Seven Boards had afternoon and four morning peaks (the South Wales Board does not state the time or date of its maximum demand). The Southern, North Western and South Western Boards changed from morning or midday to afternoon maximum demands and the Yorkshire Board went the reverse way. The South Eastern Board points out that in both of the last two years it has been charged for simultaneous loads different from those mentioned as a result of the adjustment formula which operates when the total load taken by all the Boards varies by more than 1 per cent from that estimated and forming the basis of the bulk supply tariff. In 1955-56 the Board secured relief under this formula amounting to £164,000 and last year it paid £76,000 more.

Capital Restrictions

Once again attention is drawn to the serious effects of capital restrictions. Thus the North Western Board, which last year spent £3,552,000 out of a total of £6,680,000 on reinforcing its system, says that because of the limited amount available this work is not keeping pace with load development, adding that this state of affairs cannot continue indefinitely if consumers are to receive a reliable supply. The South Wales Board also stresses that the maintenance of satisfactory supply conditions will become increasingly difficult and the Consultative Council for the Area, in a Press statement, refers to the numerous complaints of poor voltage conditions and says it has consistently urged that more capital should be made available for the vital work of improving and enlarging the distribution system. In the Eastern Area, where a substantial proportion of the country's food is produced, the Board says it is doing all it can within its restricted capital budget to help agricultural productivity by extending supplies to rural areas, but to do this and also cope with major industrial and housing developments is placing a heavy strain on the Board's organisation and financial resources.



Approximate simultaneous load curves for the London Area. The average temperatures were: 21st February, 1956, 27·3 deg F; 15th January, 1957, 35·7 deg F

By internal economies, and helped by improved load factors, several Boards report better financial results than at one time seemed likely. The North Western Board, for example, anticipated a deficit of over £1,000,000 on the year's working whereas in fact there was a surplus of £206,000. The Yorkshire Board's original estimate was for a loss of about £700,000 against an actual deficit of £441,501. The South Eastern Board takes pride in

SIMULTANEOUS MAXIMUM DEMAND (IN ORDER OF MW) AND LOAD FACTOR

Board	Maximum Demand, MW*		Time and Date				Load Factor %	
			1955-56		1956-57			
	1955-56	1956-57					1955-56	1956-57
London	1,967	2,028	5.30 p.m.	21st Feb., 1956	5.30 p.m.	15th Jan., 1957	39·0	38·7
North Western	2,021	1,991	9 a.m.	3rd Feb., 1956	5.30 p.m.	15th Jan., 1957	44·9	47·3
Midlands	1,905	1,976	9 a.m.	22nd Feb., 1956	9 a.m.	14th Jan., 1957	45·0	44·5
Yorkshire	1,785	1,875	5 p.m.	13th Dec., 1955	10 a.m.	14th Jan., 1957	47·8	48·1
Eastern	1,757	1,824	6.30 p.m.	2nd Feb., 1956	5.30 p.m.	15th Jan., 1957	43·7	44·3
East Midlands	1,419	1,526	8.30 a.m.	16th Jan., 1956	8.30 a.m.	14th Jan., 1957	46·5	45·7
Southern	1,320	1,426	9.30 a.m.	20th Feb., 1956	5.30 p.m.	15th Jan., 1957	43·2	43·3
South Eastern	1,146	1,158	5.30–6 p.m.	2nd Feb., 1956	5–5.30 p.m.	15th Jan., 1957	41·5	43·4
Merseyside and North Wales	1,008	1,032	5 p.m.	20th Dec., 1955	5.30 p.m.	15th Jan., 1957	51·1	52·7
North Eastern	968	978	4.30 p.m.	20th Dec., 1955	5 p.m.	19th Dec., 1956	50·9	53·6
South Wales	849	882	†	†	†	†	59·3	59·0
South Western	650	660	Noon	22nd Feb., 1956	9.30 a.m.	14th Jan., 1956	45·0	47·4

* Net purchases rom Central Authority and other Area Boards.
† Not stated.

the fact that for the seventh year in succession it has been able to reduce its own operating costs per kWh sold. Last year's saving of 5 per cent brought the total for the period up to more than 25 per cent, equivalent to some £9·5 million. In this way the Board has been able to limit the increase in its average kWh charge to consumers to 11 per cent compared with the 35 per cent rise in bulk supply costs. While the number of consumers served has increased by over 200,000 in the last six years, the Board's staff has been reduced by about 700.

In compliance with a national recommendation, the Area Boards' tariffs were in the main unchanged during the year, but since the end of the "standstill" period a number of increases have been announced.

As a means of spreading the payment of accounts, the stamp scheme introduced by the North Western Board continues to grow in popularity. Last year the value of 2s 6d stamps purchased by consumers was £463,000, an increase of £138,000, or 42 per cent.

Off-Peak Heating

The passing of the Clean Air Act stimulated interest in electric heating. The North Western Board reports that thermal storage type heaters aggregating about 8,000 kW were installed in various premises in its Area, including a suet refinery, shops, showrooms, canteens, laboratories and schools. A special campaign has been conducted by the South Western Board to publicise the advantages of thermal storage heating by either free-standing block heaters or floor warming installations, and as a result 5,600 kW of this type of equipment was connected compared with 2,640 kW in the previous year. In London some 4,000 kW of block type thermal storage units were connected and agreement was reached with local authorities for floor warming to be provided in 71 flats. A particularly large installation of this type for industrial premises is mentioned by the North Eastern Board. The system, installed in an engineering works, has a capacity of 3,500 kW. Another floor warming installation, of 1,000 kW, was included in a supply of 30,000 kW required for the manufacture and machining of nuclear graphite, and a further 7,000 kW of thermal storage space heating was connected by the same Board in other premises. The Merseyside and North Wales Board, which reports a considerable increase in the amount of wiring work it has carried out for consumers, states that a number of specialised installations for space heating in churches, public halls and other premises were included, among these being a floor warming installation in a block of flats in the Wirral area. Another, ten-storey, block is to be similarly heated and several local authorities have expressed interest in the system.

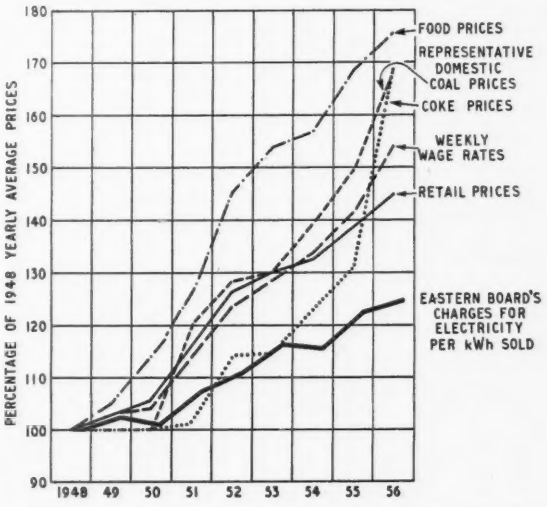
System Standardisation

The number of consumers changed from non-standard to standard supply was limited by capital expenditure restrictions. The South Eastern Board is able to report that it has passed the half-way mark in d.c./a.c. change-overs since vesting day, the number of d.c. consumers still connected being 41,860 against 87,500 in 1948. The London Board had a much bigger task. At vesting day there were 250,000 d.c. consumers apart from 525,000 receiving non-standard a.c. supplies. By the end of March last there remained only 89,000 d.c. consumers, but it has not been possible to make much progress in the reduction of non-standard a.c. supplies owing to more urgent needs.

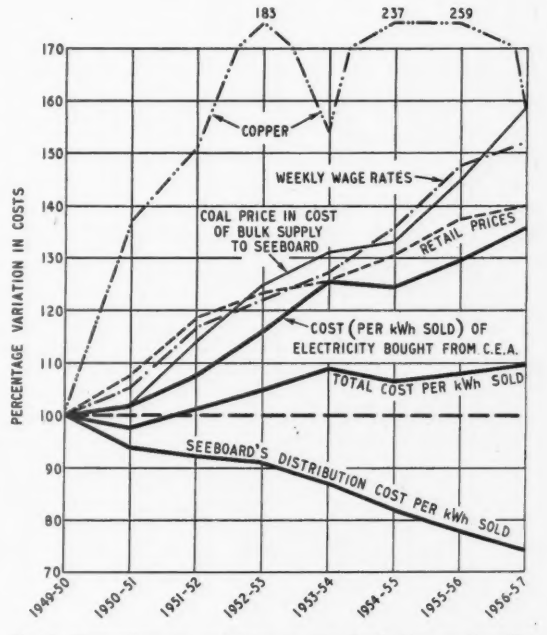
Progress in street lighting conversions from gas to electricity is reported by most Boards. In Yorkshire arrangements were made for supplying an additional 12,992 lamps; in the North Western Area 16,543 new public lamps were connected; in the Midlands 11,202; North Eastern Area 9,710; Merseyside and North Wales 8,149; and in London 7,900 (including the lighting of such thoroughfares as Shaftesbury Avenue, Regent Street and Kensington Road).

Copper v. Aluminium

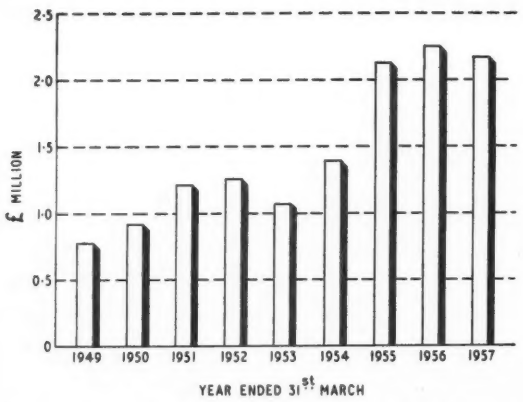
Though many of the Boards' problems were concerned with rising costs, the precipitous fall in the price of copper during the year (from over £400 to £240 a ton) also gave rise to some complexity. Previously there had been a substantial incentive to use aluminium as a substitute, but the saving is now much smaller. Thus the South



Comparison of changes in the cost of electricity in the Eastern Area with other price levels



Graph illustrating the reduction in the South Eastern Board's distribution costs compared with the general rise in prices



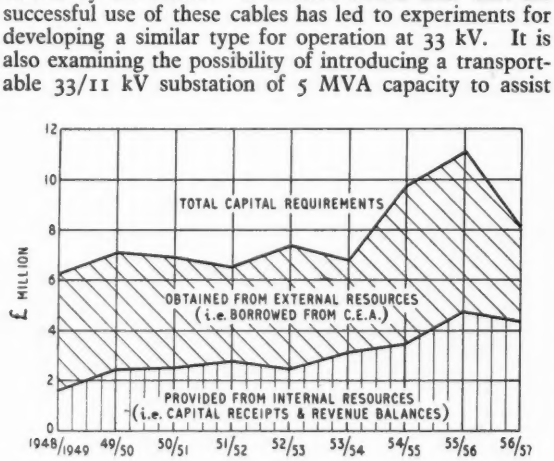
Revenue from contracting and the sale of electrical appliances in the Merseyside and North Wales Area

Western Board, while reporting considerable progress in the use of aluminium as a conductor, says that for the future much will depend upon the price of copper. The Board has been investigating the economics and desirability of using aluminium-cored cables, together with the associated problem of jointing techniques.

Extensive use has been made of steel-cored aluminium or aluminium alloy conductor by the Eastern Board for high-voltage overhead lines. It also says that plain aluminium conductor has been found a practical alternative to these types under certain conditions in the construction of the larger sizes of h.v. wood pole lines and some $3\frac{1}{2}$ miles of 33 kV line has been erected with 0·2 sq in conductor of this kind with a worthwhile saving in cost. The Board believes this to be the first line of its type erected in this country.

Two lengths of a new type of gas-pressure cable with aluminium conductor were installed by the North Western Board which states that, at the time, they showed a saving in cost and they also have the advantage of being lighter to handle.

Another development, mentioned by the North Western and South Western Boards, is the use of "jumper" trailing cables to bridge sections of line which have to be made "dead" while maintenance is being carried out. In this way the supply can be maintained to other consumers served by the feeder. The latter Board adds that the successful use of these cables has led to experiments for developing a similar type for operation at 33 kV. It is also examining the possibility of introducing a transportable 33/11 kV substation of 5 MVA capacity to assist



Capital requirements are now being financed to a greater extent from internal resources as this graph shows in the case of the Eastern Board

maintenance work and reduce the period of supply interruptions.

The Eastern Board has continued experiments on thermoplastic buried cables, on the current carrying capacity of cables, and on cable sheath corrosion. Trial installations of plastic-insulated low-voltage cable were made by the Southern Board on behalf of an Electricity Boards/Cable Makers' Association joint technical committee, and it is also trying out pulverised-fuel-ash reinforced concrete cable protection covers. Further schemes employing the h.v. single-phase earth return system have been commissioned, all of which are said to have operated satisfactorily to date. To extend the use of this type of line to networks which have the neutral point earthed through a resistance, an over-voltage relay has been developed and a number are being tried out.

The North Eastern Board reports that a certain amount of operating experience has now been gained with the experimental series capacitor installed for improving voltage conditions on a long 11 kV line supplying industrial premises. While the capacitor itself has functioned satisfactorily, some difficulties have been experienced with the spark gaps which are used to protect the equipment and further tests are being carried out.

Reducing Supply Interruptions

Remarking that lightning storms are still the cause of the greatest number of fault and supply interruptions, the Midlands Board says that investigations into preventive measure have been intensified. Auto-reclosers have been invaluable in reducing the number and duration of interruptions and improvements in fault location have also helped. On this subject the North Western Board reports the installation of several reclosers of a new design and the Yorkshire Board has established a standard method for the provision of slow-speed auto-reclosing on switchgear controlling 11 kV overhead lines from primary distribution substations.

In view of the difficulty of obtaining primary substation sites in urban areas the Yorkshire Board has found it desirable to install larger transformers than the previous maximum rating of 12·5 MVA with a nominal secondary voltage of 6·6 kV, and a new standard type having a rating of 18·75 MVA with a ratio of 33/6·7 kV has been adopted. To reduce overhead line outage in extreme conditions of frost and fog the Board is experimenting with the application of a special grease to insulator surfaces.

In previous reports the Eastern Board has referred to investigations into the use of American 33 kV load breaking switches fitted with interruptor heads. These are said to have enabled economies to be made in the design and operation of 33 kV systems. A report on the Board's experience with the original switches and with several of British design which have since become available has been circulated to the Central Authority and other Area Boards. Equipment developed by the Board for relaying alarms automatically from unattended major substations (mentioned in its 1955-56 report) has now been installed in 18 substations.

Research on wood poles is referred to by the South Western and Yorkshire Boards. The former says it has been found that a substantial proportion of poles in service are in various stages of decay, necessitating their replacement in advance of the normal time. The research now being carried out in co-operation with the Post Office Engineering Department, the Forest Research Laboratories and the pole suppliers is expected to lead to a much longer pole life as a result of correct initial treatment and maintenance.

New London Transport Substation

Fifty-Year-Old Underground Equipment Replaced

THE original substation at Charing Cross was opened in 1905 for the electrification of the District Railway, with provision to feed current to the Bakerloo and Hampstead Tubes, then under construction. Last week we had the pleasure of inspecting the new substation built by London Transport to replace the original substation and the worn-out and obsolete equipment brought into use 52 years ago.

The new substation, which will eventually feed three Underground lines—District, Northern and Bakerloo—is at present operating up to about two-thirds of its capacity and the change-over to it from the old plant is being carried out in stages to avoid any interruption to passenger service. The plant should be in full operation early next year.

The old substation, which is fed from Lots Road power station at 33⅓ c/s, was built below ground level, with four 1,500 kW rotary convertors. A fifth rotary of the same capacity was added ten years later and a sixth, with a capacity of 2,500 kW, in 1921, making the substation the largest on the Underground system. All the d.c. switchgear is the original equipment. The new substation, which is wholly above ground, is fed from Greenwich power station at 50 c/s, via Aldgate switch-house, and is being equipped with rectifying units totalling 9,000 kW. Space is available for two more 1,500 kW units to meet possible future requirements.

The site chosen for the new substation was formerly a poster bill store, which straddled the District Line station. In addition to the new electrical plant, the new building incorporates facilities for improved ventilation of the tube tunnels in the area.

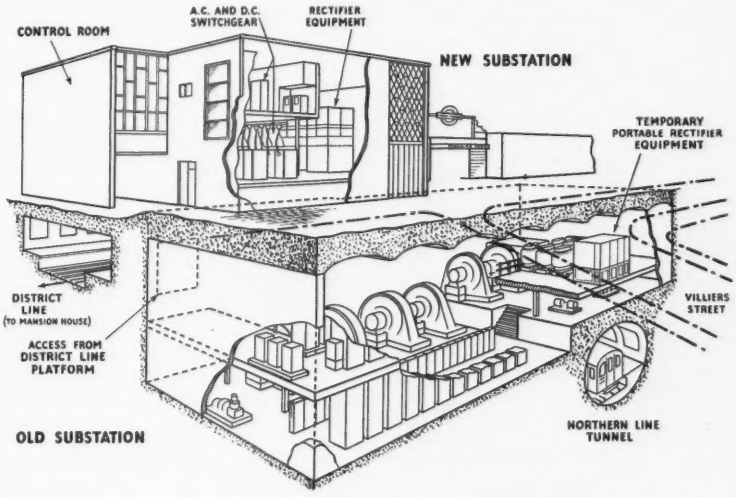
The ground floor of the new building houses the rectifiers and transformers, with the high-voltage a.c. and the d.c. switchgear, while the rectifier relay panels, lighting and signal switchgear, batteries, battery distribution switchboards and battery charging units have been installed on the upper floor. The control room, from which the power and signalling supplies for a large area will eventually be supervised, is also on the upper floor. As it will not be equipped for some time control will be effected from new temporary panels situated in an adjacent room.

In general, the new equipment is similar to that installed at Bond Street in 1954 and, like Bond Street, its manufacture and installation have been carried out by the Hackbridge & Hewittic Electric Co., Ltd., to the requirements of Mr. T. S. Pick, chief electrical engineer of London Transport.

The new substation is designed for an ultimate capacity of 12,000 kW, comprising eight rectifier sets, each of 1,500 kW rating; they comply with Class III rating of B.S. 1698 : 1950. Each set comprises a pair of 750 kW half-units, each with its own transformer and each employing six-phase rectification. Arrangements are made, however, for the combined set to operate as a twelve-phase unit. As at Bond Street, the transformers are closed-circuit air-blast cooled.

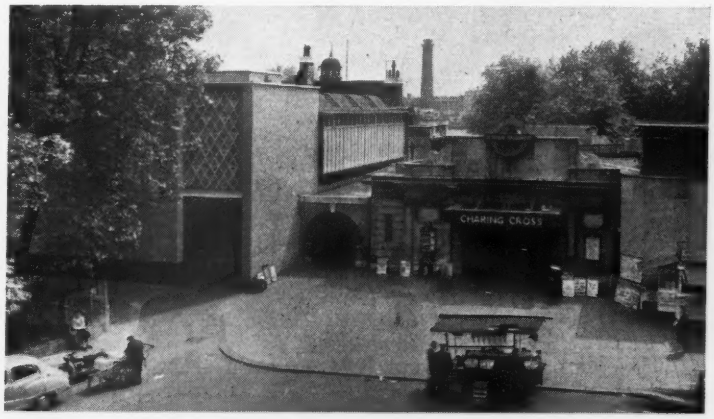
The rectifier bulbs are mounted above the transformer housings. The interphase transformers, fan control reactors and auxiliary transformers are situated between the pair of main transformers forming a twelve-phase set. It would have been impossible to get the required capacity of converting plant into the space available, without using this type of construction. Each 1,500 kW set requires a floor area only 9ft square.

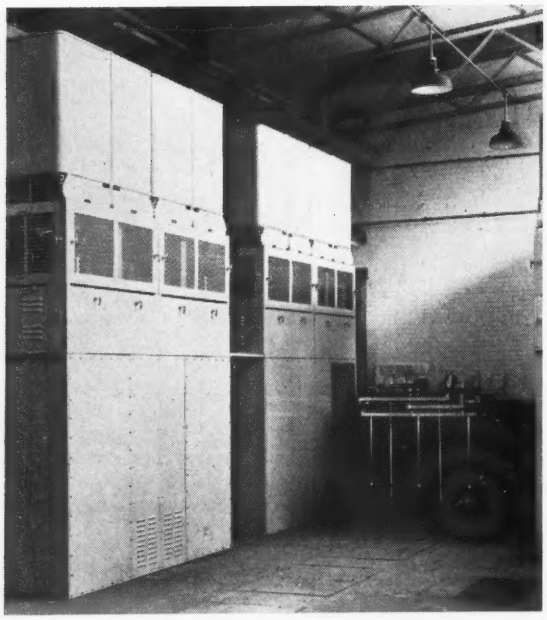
The high-voltage a.c. switchgear is by Switchgear & Cowans, Ltd., and comprises a bank of fourteen type



General arrangement of the old and new substations

High-level view of the new Charing Cross substation building showing the loading bay entrance, with the "Exit" footbridge alongside





Nos. 4 and 6 rectifier sets, with the transformer withdrawn from the right hand half-unit of No. 6 set

FB31, vertical isolation, compound-filled 11 kV units, each with a rupturing capacity of 350 MVA. These cater for three incoming feeders, seven rectifiers, two bus-section switches, one outgoing feeder, and one lighting transformer feeder. Protection on the incoming feeders is by Translay relays (instantaneous), as well as back-up protection, comprising inverse time overload and earth leakage relays. There is also frame earth leakage protection. The rectifier circuit-breakers have overcurrent and earth fault protection and means for remote load indication.

Modernisation of the substation has entailed the provision of three new 11 kV 0·25 sq in three-core, paper-insulated, lead alloy sheathed feeder cables from Aldgate to Charing Cross via the District Line tunnels, together with a pilot cable for Translay protection purposes. These cables were supplied by W. T. Glover & Co. and installed by London Transport staff.

The 630 V d.c. switchgear is in two banks, the positive circuit-breakers in one and the corresponding negative contactors in the other. The two banks face each other, and the sequence of the units is so arranged that the positive circuit-breaker faces its corresponding negative contactor. This equipment was supplied by Bertram Thomas (Engineers), Ltd., and comprises truck-type draw-out units. There are 25 cells in each bank, but two are skeleton units and will be equipped if and when the other two rectifier sets are installed. One pair of these cells contains emergency trucks for use as temporary replacements in case of a fault in, or damage to, the equipment of any other track feeder unit. The rating of the circuit-breaker and contactor on these standby trucks is 3,000 A.

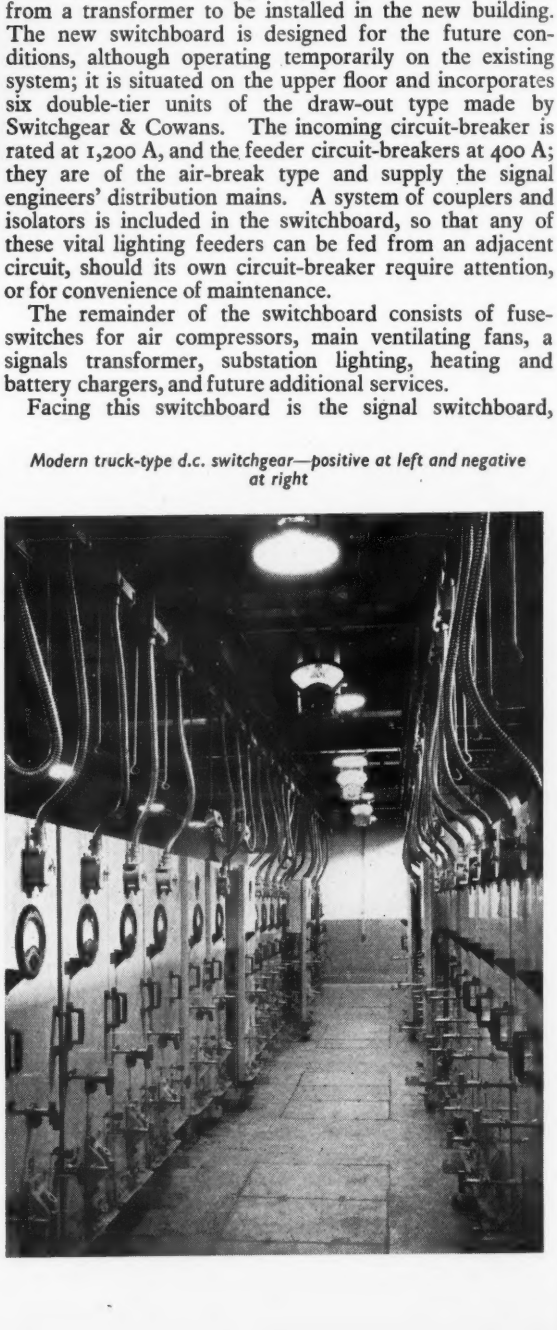
Both the circuit-breakers are electrically closed, the former being of the high-speed type. Those for the rectifiers are rated at 4,000 A while the outgoing feeders are 3,000 A. The former trip only on reverse current (which would result from a fault in the associated rectifiers) and the tripping of any one of these opens the associated high-voltage a.c. breaker. The feeder circuit-breakers do not reclose automatically after tripping on a fault or overload, but give an alarm at the controlling point; the operator then restores the supply at his discretion. The circuit-breakers are closed by push-button control and latch in, the negative contactor following automatically. Similarly, on opening, the contactors follow the breakers, since their closing and holding circuits are completed via auxiliary contacts on the circuit-breaker. Two pairs of couplers of 4,000 A rating divide these twin switchboards into three sections, and in the first instance two rectifier sets will feed into each section.

For the time being, a low-voltage a.c. supply for station lighting and auxiliary purposes is obtained from an existing group of three single-phase transformers in the old substation at 220 V, 33⅓ c/s, but later the system is to be standardised at 415 V, 50 c/s, four wire and fed from a transformer to be installed in the new building. The new switchboard is designed for the future conditions, although operating temporarily on the existing system; it is situated on the upper floor and incorporates six double-tier units of the draw-out type made by Switchgear & Cowans. The incoming circuit-breaker is rated at 1,200 A, and the feeder circuit-breakers at 400 A; they are of the air-break type and supply the signal engineers' distribution mains. A system of couplers and isolators is included in the switchboard, so that any of these vital lighting feeders can be fed from an adjacent circuit, should its own circuit-breaker require attention, or for convenience of maintenance.

The remainder of the switchboard consists of fuse-switches for air compressors, main ventilating fans, a signals transformer, substation lighting, heating and battery chargers, and future additional services.

Facing this switchboard is the signal switchboard,

Modern truck-type d.c. switchgear—positive at left and negative at right



which is in two sections; one portion operates at 600 V, single-phase, and is fed from a transformer in the old substation for supplies to the District and Bakerloo Lines; the other gives a 440 V supply for the Northern Line and for tunnel telephones.

The track feeder, escalator, lighting and pump feeder cables, which are the responsibility of the signal engineer, are being lengthened and re-routed to the new substation; the new cabling being paper insulated, lead covered of the pre-impregnated, non-bleeding type. Track feeder cables are 1·4 sq in single-core, escalator cables of 0·4 sq in concentric, while the lighting cables are three-core 0·25 sq in shaped conductor cables; sheathing is B.S. lead alloy "C." A mechanical sealing end, developed by the signal engineer, is being used for terminating the track end of each track feeder cable. Due to limited clearances, the existing cable runs are being used and modernised where necessary.

The cables were manufactured by W. T. Glover & Co., Ltd., and they were installed by London Transport.

The substation control cabling is carried in sheet-steel trunking, and carefully planned marshalling cabinets, at one end of each line of d.c. truck switchgear, facilitate the installation, checking and testing of the control and indicating circuits in the substation. The final control marshalling cabinet is situated on the upper floor adjacent to the rectifier relay board. Without these marshalling arrangements, the change-over of the traction current feeds from the old substation to the new would be virtually impossible during the few night hours when the station can be shut down.

As the substation serves three separate Underground lines, the change-over from the old to new cannot be carried out overnight. Instead, the track feeders are being dealt with one at a time, and only at week-ends, when longer track possessions are possible. To date, the four sections of the District Line have been changed over and are now fed from the new substation.

Mullard Research Laboratories

LAST week we visited the Mullard Research Laboratories at Salfords, Surrey, to see some of the many aspects of the work being carried out there. The increasing demands made on the Laboratories have necessitated the erection of new buildings in order to increase the scope of the laboratory facilities and ancillary services. The main addition is a two-storey laboratory building flanked by a four-storey office block, providing a total of 28,000 sq ft of floor space.

Work at the laboratories is classified broadly in seven separate divisions and comprises solid state physics; microwave tubes, special tubes, such as image convertors and storage tubes; electronic instruments and equipment, including industrial control gear and ultrasonic equipment; telecommunications; applications; engineering; and other services. Apart from the work carried out for the various manufacturing divisions of the company, the laboratories frequently operate as an extension of the experimental facilities of a Government scientific establishment.

Among the many interesting exhibits on show was the 4 MeV machine in the linear accelerator laboratory which can produce an electron beam, gamma rays, or neutrons. This laboratory is engaged in the development, construction and application of travelling-wave electron linear accelerators for use in nuclear and medical research, for industrial radiography and irradiation, and for radiological purposes. Samples of polyethylene which had been subjected to high energy electron irradiation were exhibited which illustrated that it is possible to achieve varying degrees of hardness in polyethylene.

Vulcanisation of rubber, normally involving additions such as sulphur and the application of heat, can also be brought about by irradiation alone, the product being available for immediate use. This is especially useful in the case of silicone rubbers as it avoids the need to eliminate harmful by-products. Further important applications are the sterilisation of drugs and surgical equipment, sterilisation, pasteurisation and disinfestation of food, and initiation of chemical reactions (polymerisation, oxidation, etc.).

In the Television Laboratory four types of display device which actually produce a colour picture were seen. First there was the high quality trinascope in which three separate single-colour pictures are viewed through reflecting/transmitting mirrors. Next, in the projection receiver three single-colour pictures on small cathode-ray tubes are magnified and combined by an optical projection system. Thirdly, two complete test equipments for 21in and 19in "shadow" mask tubes were shown. Each colour is supplied by a separate electron gun directed on to minute dots of phosphor which are placed so that they receive the correct electrons after passage through holes in the "shadow" mask.

The fourth type of equipment, chromatic tube test gear, is designed to facilitate the study of the chromatic or "Lawrence" tube. In this tube there is one gun only and the electrons are switched in a time sequence on to lines of different colour phosphors. This was the first time that this particular type of tube had been demonstrated in this country.

Work is being carried out in this section to determine the kind of television receiver which will result from the use of a particular display device and the degree of accuracy which must be maintained in all aspects of the display devices to satisfy the human eye.

Exhibits representative of the work of the Engineering Division were also on view. They included a demonstration of a printed circuit technique using ultrasonics to accelerate etching, ultrasonic drilling, and a simple component insertion machine.

In all, the list of exhibits totalled more than fifty items representing a wide range of interest. The company believes that the housing of work in electronics, vacuum physics and solid state physics under one roof is most valuable.

New Mullard office block and laboratory building at Salfords, Surrey

EUROPEAN FREE TRADE AREA

A JOINT report on the European Free Trade Area, by the Association of British Chambers of Commerce, the Federation of British Industries and the National Union of Manufacturers, was published this week. The three organisations set out their views on the matters which should be covered by the E.F.T.A. Convention, those which they do not think appropriate for inclusion, and those on which they are not yet in a position to express a definite opinion. The introduction to the report emphasises that neither in the three organisations nor in industry and commerce generally is there a generally accepted consensus of opinion about the merits of the E.F.T.A. proposals as a whole, but they are unanimously of the opinion that whatever views are held as to what the result for the United Kingdom may be, it remains a balance compounded of relative advantages and disadvantages. There is no question of the United Kingdom being forced by the existence of the European Economic Community to seek association with it at any price.

Certain basic requirements are proposed. The organisations suggest that the Free Trade Area in Europe, if the United Kingdom is to enter it, should not be incompatible with the maintenance of the existing structure of Imperial Preference and the Convention establishing the E.F.T.A. should be so shaped that Imperial Preference is not jeopardised. They support the Government's determination not to surrender this country's right to maintain its own tariff policy *vis-à-vis* the outside world and not to join in a common external tariff with the E.E.C.

Turning to the matters which the three organisations consider should be covered by the Convention, the report says that the rules for the progressive reduction and eventual abolition of tariffs as between the members of the E.F.T.A. should be such that the timing of the dismantling operation in the E.E.C. and E.F.T.A. will broadly coincide. Rules will have to be agreed defining the origin of goods qualifying for E.F.T.A. agreement. There should be a general statement or provision against artificial barriers or inducements by Governments affecting trade in goods between members of the E.F.T.A., and there should be rules forbidding all forms of Government export subsidies and incentives and all forms of Government aids which discriminate in favour of exports compared with goods sold or services rendered at home.

The use by Governments of transport as an instrument of discrimination, such as the enforcement of specially low or preferential transport charges for exports or as subsidies to particular producers should be forbidden, and there should be a rule against Government export restrictions. Some general statement should be included in the Convention to the effect that dumping is inconsistent in principle with the objects of the E.F.T.A. The report supports the approach of the Government towards escape clauses, but expresses the opinion that the Convention should be so framed as not to prevent Governments from taking appropriate measures to assist hard-hit industries and firms.

Dealing with matters which it is considered are not appropriate for inclusion in the Convention, the report mentions taxation, wage costs and social charges and expresses the view that State intervention in industrial relations should not be regarded as necessary for the creation of a E.F.T.A. The three organisations would view with apprehension forms of European supervision superimposed on those provided by the Restrictive Trades Practices Act, and express the view that should any such proposals be contemplated, the Government should consult industrial organisations.

With regard to standards, the report states that in so far as Government regulations and requirements were so operated as to discriminate against imported goods, the matter would be subject to the suggested E.F.T.A. rules against protective devices. It is understood that the British Standards Institution has the whole matter under review.

Matters on which the three organisations are not yet in a position to express a definite opinion include access to raw materials, State trading patents, and trade marks. Copies of the report are available from the Federation of British Industries, 21, Tothill Street, London, S.W.1, price 2s 6d.

Air Pollution

AS the substance of his presidential address at the National Smoke Abatement Society's conference at Hastings on 2nd to 4th October, Dr. R. Lessing took "The Primary Sources of Air Pollution." These, he contended, were in large part, the "natural" dust in coal, over 20 million tons of which a year were fired in powdered form. Even with an extraction efficiency of 99 per cent more than 100,000 tons of flue dust escaped into the atmosphere, and this could be much reduced by removing a substantial portion of the high-ash component at the collieries. The difficulty and expense of extracting sulphur oxides once they had formed militated against a general adoption of flue-gas treatment. Sulphur inherent in pure coal could not be removed, except partly in the carbonising process, but a high proportion could be washed out by cleaning at the pits, where recovery of heat value and sulphur from the washery was possible by modern means, which would also lower the amount of ash.

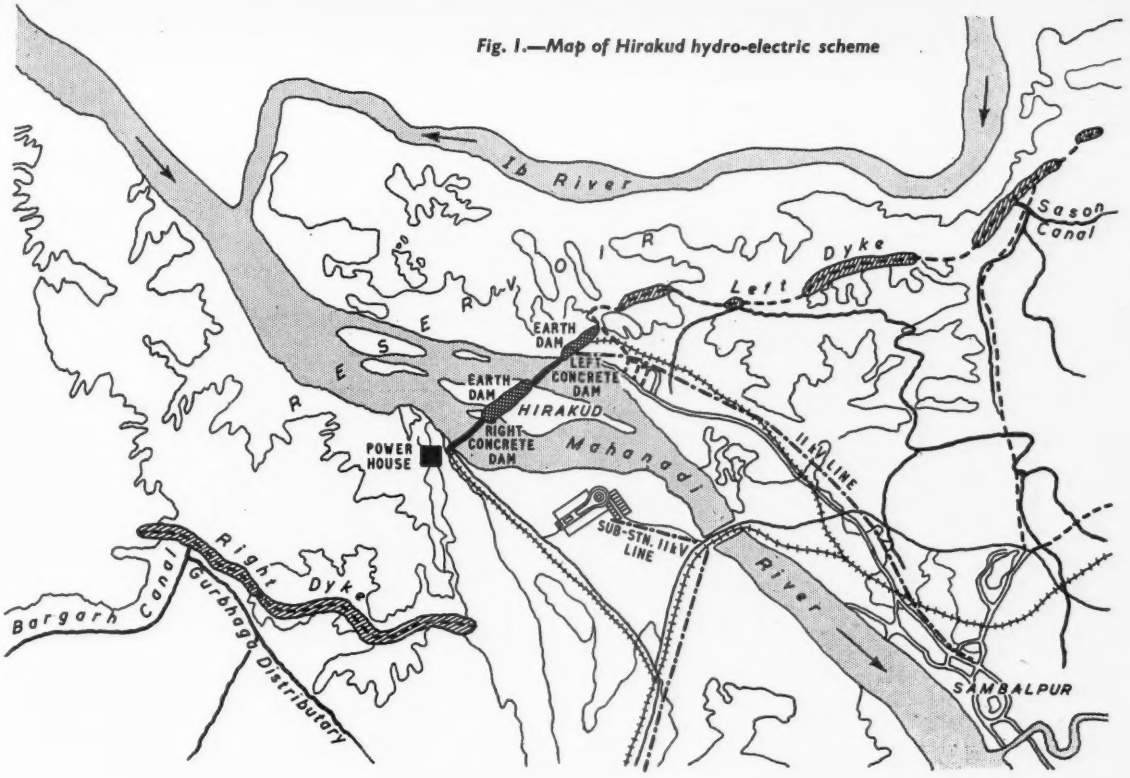
The eighth Des Voeux Memorial Lecture, on "Meteorology and Air Pollution," by Sir Graham Sutton (Director-General of the Meteorological Office), was read in his absence abroad by Mr. P. J. Meade (Assistant Director). The automatic mixture of air through its turbulence, he said, was essential to life in large communities. The height of chimneys was an important factor. By doubling the height, the greatest concentration of smoke on the ground would be reduced to one-quarter. If the chimney of an average house was 25ft above ground and of an industrial stack 200ft then, for equal amounts of smoke, the former contributed 64 times as much to the concentration at breathing level. In a town having some tens of thousands of houses, all burning coal, and one medium-sized electric power station, there seemed little doubt that the greater part of the sulphurous smoke inhaled by those in the streets must come from the houses.

Atomic Power Station Films

THE building of Calder Hall nuclear power station and the fast breeder reactor at Dounreay, Caithness, presented problems of construction which had never had to be tackled before. A series of films taken during the building operations is now being made available by the United Kingdom Atomic Energy Authority to show how it was done.

The filming was carried out on behalf of the Authority by Ace Distributors, Ltd., 14, Broadwick Street, Wardour Street, W.1 (telephone: Gerrard 3165), from whom 35 mm and 16 mm copies can be obtained on loan, free of charge. Titles of films immediately available are:—"The Construction of Calder Hall" (running time 40 min); "Heat Exchangers at Calder Hall" (28 min); "Engineering at Calder Hall" (39 min); and "The Dounreay Sphere" (35 min).

Fig. 1.—Map of Hirakud hydro-electric scheme



HIRAKUD HYDRO-ELECTRIC SCHEME

Extensive Development in Southern India

THE Hirakud scheme, which is being carried out by the Government of India in Orissa, near Sampalpur, and was recently officially inaugurated by Mr. Nehru, the Prime Minister, has been designed to provide both hydro-electric power and to supply an extensive system of irrigation canals over a wide area. It will facilitate the development of the mineral resources of the State, which include large deposits of iron ore and coal, the establishment of both heavy and light industries and the improvement of cultivation. For these purposes use is being made of the River Mahanadi, which flows for a distance of 300 miles through the State and drains an area of 51,000 square miles before falling into the Bay of Bengal.

As shown in the map reproduced in Fig. 1, the principal civil engineering feature of the scheme is the so-called main dam, which has been constructed across the river at a place where it flows through three channels, thus forming two islands—Hirakud and Kolarikud. The total length of this dam structure is 15,748ft and it consists of five sections: a masonry dam, 948ft long, from which water is supplied to a power house; a concrete spillway with masonry transitions 1,180ft long, across the right channel; an earth-filled dam, 7,540ft across Hirakud island; a second concrete spillway, also with masonry transitions and 1,640ft long, across the left channel; and another earth-filled dam, 4,440ft long, on the left bank. This composite structure is flanked on the left-hand side by earthen dykes, of a total length of 32,275ft, which are divided into five sections by hillocks, and by a continuous length of dykes, 35,500ft long, on the right. From these dykes channels of various widths and capacities are taken off for the irrigation of

Fig. 2.—Spillway dam across the right channel of the river with power station in the foreground

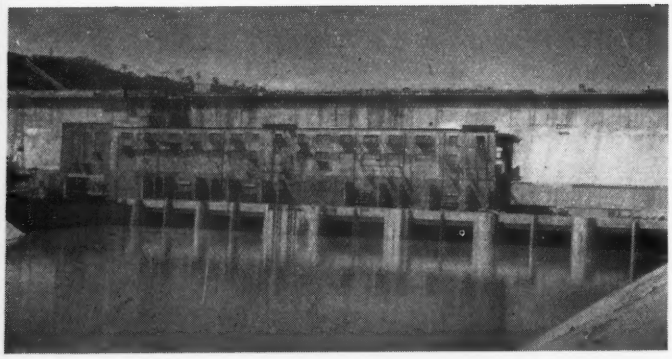


Fig. 3.—Intakes to power station penstocks

the surrounding country. Work on this project was begun in 1949 and the main part of the construction was completed in August, 1956, although some power plant remains to be installed.

The average annual discharge of water from the river at the dam is some 2,200 million cu ft, most of which occurs between July and December. The " live " storage, however, is only 200 million cu ft, an amount which will ensure both that the reservoir is filled every year and that its level during the monsoon will be such that heavy floods will be absorbed and later discharged gradually into the lower reaches.

Power Dam

The power dam, of which illustrations appear in Figs. 2 and 3, consists of seven blocks, each containing a partially steel-lined penstock, 25ft in diameter, through which water is supplied to the turbines. The right-hand spillway section, which is also shown in Fig. 2, contains twenty-four 12ft by 20½ft sluices, openings for which have been left in the lower portion of the structure and through which heavy silt-laden water can be discharged. These openings are controlled by vertical sliding gates which are operated by cranes. There are also thirteen crest bays, each of which is 51ft wide and is controlled by 20ft high Tainter roller gates.

The left-hand concrete dam, which is illustrated in Fig. 4, consists entirely of spillways and comprises 40 sluices in the lower portion, these being of the same dimensions as those in the right-hand section. There are also 21 crest bays of the same size as those in the right-hand portion. As in the right-hand portion, too, control of the flow at this point is by sliding and Tainter gates.

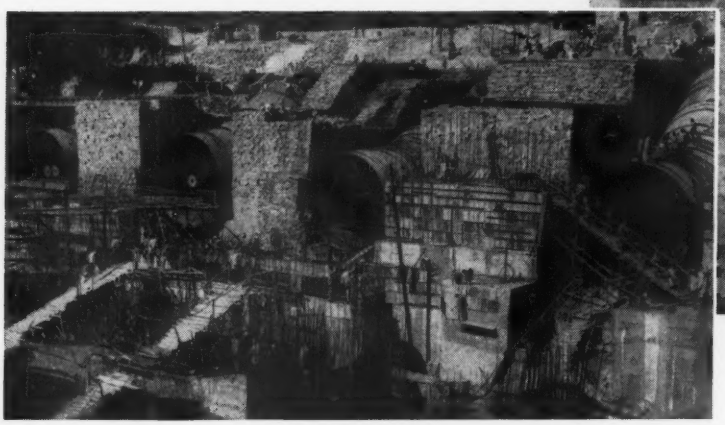
Both spillway sections have been constructed of mass concrete with vertical faces on the upstream sides and downstream faces with a batter of 0·7 to 1, while the crests lie on a parabolic curve. Their maximum height is 200ft. As will be seen in Fig. 2, above the crests are bridges carrying a road.

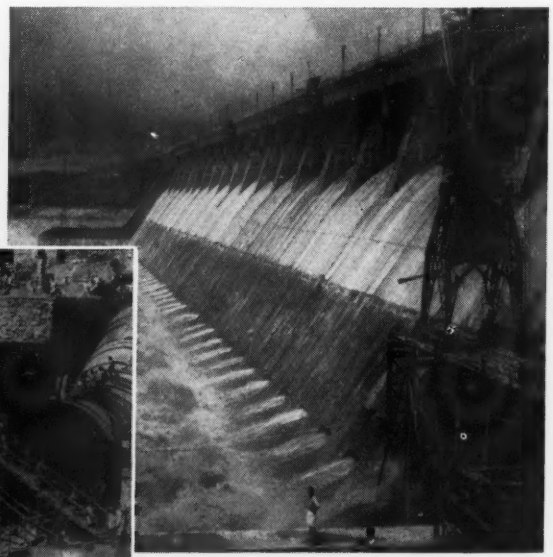
The construction of these two dams required the excavation of just over 22·5 million cu ft of material, of which 16·1 million cu ft was of rock. This excavation was carried to depths varying from 10ft to 30ft for the left spillway, from 20ft to 45ft for the right spillway, from 35ft to 73ft for the power dam and from 65ft to 71ft for the power house. The quantity of concrete and masonry used was 391,000 cu ft.

The preparation of the foundations was difficult and complicated owing to the peculiarities of the geological strata, the presence of sub-soil water and the weather, which allowed work to be performed for only six or seven months in the year. In carrying it out a coffer dam was first built across the left-hand channel and the river diverted through the middle and right-hand channels, a procedure which was facilitated by the fact that upstream of the dam site the river divides into two branches. Construction was then carried out during three seasons until the dam had been completed up to the level of the lower sluices. Subsequently, a coffer dam was also built across the right-hand channel.

During the 1952-53 and 1953-54 seasons all the water was passed through the middle channel, while in 1954-55 and 1955-56, with the right-hand channel still closed, it was allowed to flow over the left-hand spillway. In the latter year, too, the earth dam mentioned above was built to a height of 100ft across the middle channel. Between 1950 and 1955 the power dam and the power house site were encircled by a bund, so that work at these places could also be carried out during the monsoon.

As mentioned above, water for the generation of power is supplied through penstocks 25ft in diameter, which in Fig. 5 are shown being placed in position. Admission to these penstocks is through semi-circular trash racks of reinforced concrete and they are controlled by 31ft by





Above: Fig. 4.—Spillway dam showing upper and lower sluices. Left: Fig. 5.—Steel liners for power station penstocks

18ft hydraulically operated gates. At present only four of these gates, one for each set, have been installed, the other openings being closed either by steel stop logs or a concrete curtain wall. All the openings can also be closed by emergency gates in the face of the dam.

As shown in Fig. 2, the power station is situated at the extreme right-hand toe of the masonry dam. Its equipment will ultimately consist of five 37·5 MW and two 24 MW sets. Of these, two 37·5 MW and two 24 MW units have already been installed, while a third 37·5 MW unit has been sanctioned. There is also a 600 kVA house set.

The 37·5 MW sets have been manufactured by the English Electric Co., Ltd., and consist of a vertical shaft feathering propeller turbine, which runs at a speed of 150 r.p.m. under a head of 87ft. These sets are the largest so far installed in India, their weight being 520 tons and the overall diameter 26ft. The turbine is directly coupled to the alternator, which generates three-phase current at 11 kV and 50 c/s. A main and pilot exciters and a permanent magnet generator for the governor pendulum drive are mounted on the same shaft.

The 24 MW sets, one of which is shown in course of erection in Fig. 6, were built by the Protos Engineering Co. Each consists of a Francis turbine, which operates under the same hydraulic conditions as the larger units. It is directly coupled to a vertical shaft alternator above which there are again main and pilot exciters and a governor generator.

In all cases the alternators are of the water-cooled ventilated type and each has two guide bearings. There is also a Michell thrust bearing, which is located below the rotor on the 37·5 MW and above it on the 24 MW sets. Brown-Boveri automatic voltage regulators are installed on all the machines.

Main Substation

The main alternators are solidly connected to 11/132 kV forced-oil water-cooled transformers, which were manufactured by the British Thomson-Houston Co., Ltd., and are installed on a deck over the draught tubes. The

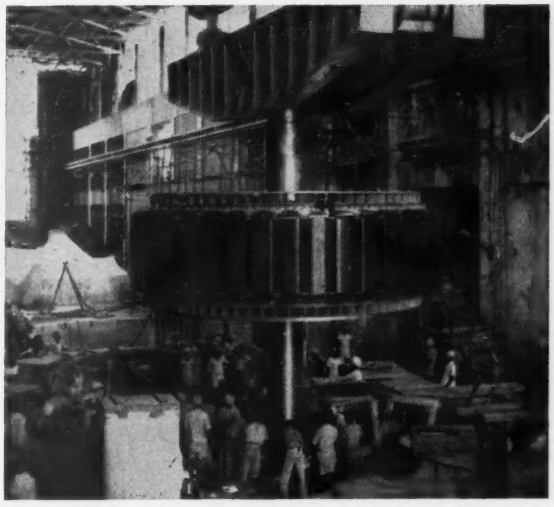


Fig. 6.—Rotor of 24 MW alternator under erection

132 kV windings of these transformers are in turn connected by copper tubes across the tailrace to an outdoor switching station, which is shown nearing completion in Fig. 7. This station consists of a galvanised steel structure, with seventeen bays to accommodate the same number of conventional bulk oil circuit-breakers, fourteen of which are at present installed.

Double-circuit lines, operating at 132 kV, will be run from this switching station to an aluminium plant, which is at present under construction four miles away, and to steel works at Rourkela, a distance of 100 miles, the prospective loads being 55 MW and 60 MW respectively. In addition, a single-circuit line 160 miles long will be run to Chowdwar, near Cuttack. Power will also be stepped down from 132 kV to 66 kV in two 12·5 MVA transformers and fed into single-circuit lines to Bargarh and two other outlying districts. In addition, these trans-

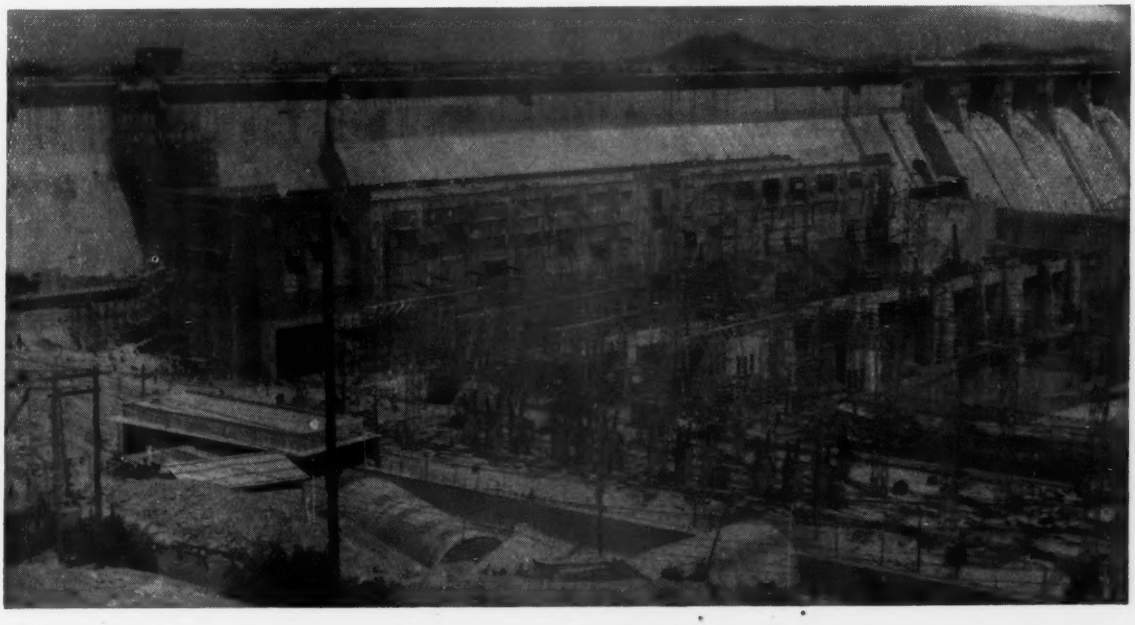


Fig. 7.—132 kV switching station

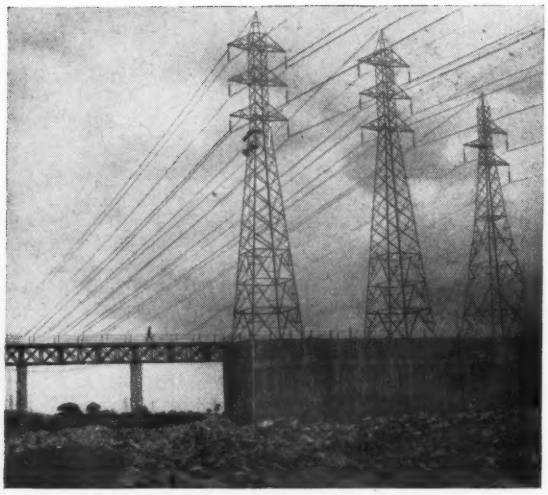


Fig. 8.—132 kV and 66 kV transmission towers

formers will be connected to two 2 MVA, 66/11 kV units from the low-voltage sides of which the station services and all the power and lighting requirements of the dam will be supplied through two 600 kVA and two 250 kVA, 11 kV/400 V units. All the equipment in the power house and switchyard will be remotely controlled from a room in the main building.

Transmission System

Both the 132 kV and 66 kV transmission lines are carried on lattice steel towers the design of which will be clear from Fig. 8, which shows those carrying double-circuit and single-circuit conductors across the river near the right spillway. At this place the towers are mounted on masonry foundations. The double-circuit towers, which are of high tensile steel and are fully galvanised, were imported from the Societa Anonima Elettrifazione, Milan, while the single-circuit towers were designed by British Insulated Callender's Cables, Ltd., and were fabricated in India from standard steel sections. On these single-circuit towers only the cross-arms and upper portions are galvanised, the lower sections being treated with aluminium paint.

The conductors for the 132 kV lines consist of 30 strands of aluminium and seven strands of galvanised steel, the diameter of both being 0·118in, giving a nominal copper equivalent of 0·2 sq in. The conductors for the 66 kV lines consist of six strands of 0·186in aluminium and either seven strands of 0·062in or one strand of 0·186in steel, giving in both cases a nominal copper equivalent of 0·1 sq in. The earth wires on both lines consist of 12 strands of 0·111in aluminium and seven strands of 0·111in galvanised steel, giving a nominal copper equivalent of 0·07 sq in. For earthing, 1in galvanised iron pipes, driven 10ft into the ground, are connected to the towers by 0·1 sq in tinned copper tape. The conductors were obtained either from British Insulated Callender's Cables, Ltd., the National Insulated Cable Co. of India, Ltd., or Aluminium Industries, Ltd., of Kundara.

The original insulators on both the 132 kV and 66 kV lines were of toughened glass and were manufactured by Pilkington Brothers, Ltd. At a later stage, however, brown glazed porcelain insulators manufactured in Japan were substituted. All the insulators are of the ball-and-socket type, those of the suspension pattern being used for angles up to 2 deg and tension strings where this value is exceeded. Double-tension strings are employed at railway crossings. On the 132 kV line the strings consist of either nine or ten 10in discs, while five or six elements are employed on the 66 kV lines. On towers adjacent to the substations the number of elements is less by one or reduced arc gaps are used. Arcing horns are usually provided at the ends of the lines.

Compression joints are universally employed. Stockbridge vibration dampers have been installed at all strain positions, two per conductor being employed at the wider river crossings. At the suspension points Bates dampers are the standard practice. Both snail type and bolted crimp clamps have been used on the angle and terminal towers, the suspension clamps being of the trunnion type with aluminium liners. These suspension clamps are designed to slip at a tension equal to that of 75 per cent of the maximum working tension of the conductor.

Erection of the towers was carried out departmentally. About 30 miles of the 132 kV line from Rourkela to Joda lie through the Saranda Forest, which is in the Bihar territory and is infested by elephants and other wild beasts. Manual labour was used to carry the loads to the tower positions along specially built approach roads and causeways.

A total of 80 miles of double-circuit and 160 miles of single-circuit 132 kV line, as well as 25 miles of single-circuit 66 kV line, were completed during two seasons. The rest of the work, consisting of 75 miles of 132 kV line as well as 100 miles of 66 kV lines, is planned for completion before the onset of the 1957 monsoon.

The 132 kV substations at Chainpal, Chowdwar and Jharsuguda are now being equipped with oil-immersed natural-cooled star/star transformers with a closed delta tertiary winding of a capacity not less than 30 per cent of the rated value. At Rourkela the capacity will be 25 MVA to allow for the future connection of synchronous condensers. All the transformers are provided with remotely controlled on-load tap-changing equipment on the high-voltage side to give a variation from 20 per cent to 5 per cent above normal in steps of $1\frac{1}{4}$ per cent. It was originally specified that they should have an impulse level of 650 kV, but this was reduced to 550 kV as the result of type tests.

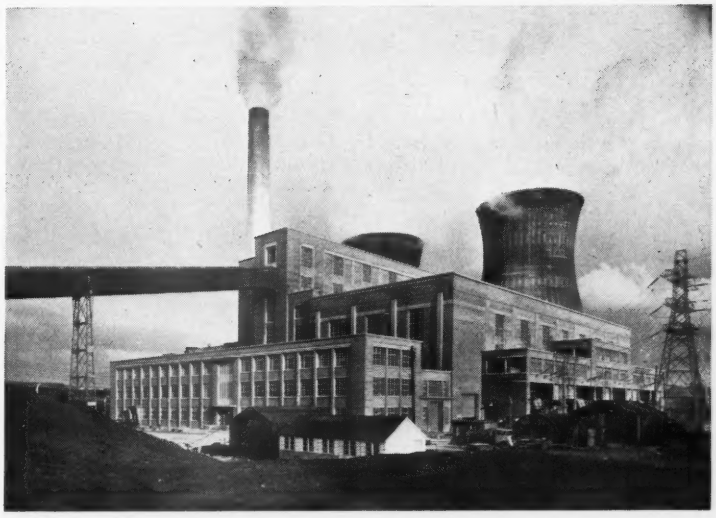
The 66 kV substations at Bargarh, Joda, Noamundi, Kuldiha and Koira are equipped with the same type of transformers and with tap-changing equipment giving a variation from 3 per cent below to 9 per cent above normal.

The switchgear at the 132 kV substations at Chainpal, Chowdwar and Jharsuguda and at the 66 kV substations at Noamundi, Kuldiha and Koira consists of bulk oil circuit-breakers, while the 66 kV equipment at Joda and Bargarh is of Siemens-Schuckert make and is of the expansion type.

The resources of the Hirakud reservoir are such that it is proposed to lead the tail water from the power station, that has been described above, through a channel 12 miles long to a second station with a capacity of 72 MW, while 100 miles lower down, where the Mahanadi flows through a gorge, there is an ideal site for a 200 MW station. In addition, there are two sites in the State on the River Brahmani where a total of 200 MW can be developed and others on the River Baitarani, which falls through 800ft in eight miles, where 250 MW can be installed. These three rivers alone, when fully harnessed, could be utilised to feed 800 MW of plant, while in Southern Orissa resources amounting to a further 200 MW are available.

We are indebted to the *Indian Journal of Power and River Valley Development* for the information and photographs in the above article.

GENERATION and DEVELOPMENT



Wakefield "B" 240 MW base-load station

Wakefield "B" Power Station Opening Ceremony

On Friday last Wakefield "B" generating station was officially opened by the Mayor of Wakefield (Councillor M. Fitzpatrick), who also unveiled a commemorative plaque.

It is twelve months since we published an illustrated description of the Wakefield station (see *Electrical Review*, 12th October, 1956) and at that time only two of the four 60 MW turbo-alternator/boiler units had been commissioned. To-day the station is operating at its full capacity with four 60 MW sets. It is reputed to be the most compact power station in the country, having a building capacity of only 28·7 cu ft/kW. Apart from this the price has, by careful design, been kept down and the cost per kW of plant installed is under £50. The station has a high efficiency and at the moment operates at 29·6 per cent, which is expected in time to be improved to 30·25 per cent. The turbo-alternator sets were supplied by the English Electric Co., Ltd., and the boilers are Foster Wheeler units.

Sir Josiah Eccles, deputy chairman (operation), C.E.A., said that despite interesting and spectacular atomic power developments coal would remain for very many years to come the main fuel for our power stations. The Authority was constructing and equipping the equivalent of seven Wakefield power stations each year, and that was the measure of the need for the power required to maintain our place in the world. Twenty-eight more stations were in the process of construction or were being planned. He added that up to now nearly all the electricity had been produced from coal, but if the demand for power continued in the way anticipated the time was not far distant when there would not be sufficient coal to meet their needs.

Sir Josiah remarked that the Wakefield station was very nearly the cheapest in cost per kW and had the cheapest electrical output of any of the 162 stations in the country, and added, "It is a symbol of the kind of future we in this country can command if we desire it and are prepared to exert enough energy and initiative to secure it. We shall stop limping along from crisis to crisis just as soon as we stop complaining about the deficiencies of others and exhorting others to do better and start in and get on with our respective jobs, overcoming our difficulties as they arise and earning the co-operation of our fellows and the goodwill of our customers. There is no other way. What is needed is a 10 per cent increase in output by each of us without any increase in the total cost of production other than the cost of the extra raw materials involved."

Sir George Nelson, chairman of the English Electric Co., Ltd., speaking on behalf of the contractors, with Mr. C. E. H. Verity, director of Foster Wheeler, Ltd., said that thermal stations to-day were costing no more than before the war, and the cost of electricity in the nine years since vesting day had risen by only 28 per cent. Through research and development in the electrical industry in co-operation with the engineers of the C.E.A. those responsible for thermal plant design had produced equipment that was practically balancing rising costs of coal, transport and operation. Sir George also wished the Authority success in the construction and operation of a new station at Thorp Arch, for which he believed the largest steam generating set in the world had been specified.

ELECTRICITY SENT OUT BY AREA BOARDS FOR THEIR CONSUMERS

Area Board	Totals for August (Million kWh)			Twelve Months' Totals Ended 31st August (Million kWh)		
	1956	1957	Inc. or Dec. %	1956	1957	Inc. or Dec. %
London	421·5	431·8	+ 2·4	6,891·4	6,944·9	+ 0·8
South Eastern	294·6	308·5	+ 4·7	4,366·0	4,471·8	+ 2·4
Southern	364·3	389·6	+ 6·9	5,235·8	5,563·7	+ 6·3
South Western	199·5	207·2	+ 3·9	2,687·8	2,797·7	+ 4·1
Eastern	466·2	491·7	+ 5·5	6,921·4	7,222·4	+ 4·3
East Midlands*	398·2	423·7	+ 6·4	5,923·8	6,172·4	+ 4·2
Midlands*	469·6	500·6	+ 6·6	7,701·3	7,849·5	+ 1·9
South Wales*	302·8	335·2	+10·7	4,461·4	4,692·1	+ 5·2
Merseyside and North Wales*	342·4	358·5	+ 4·7	4,648·2	4,858·0	+ 4·5
Yorkshire*	523·7	559·1	+ 6·8	7,700·4	8,066·1	+ 4·7
North Eastern*	311·6	330·0	+ 5·9	4,417·5	4,659·5	+ 5·5
North Western*	600·4	608·4	+ 1·3	8,193·2	8,315·5	+ 1·5
Total all Area Boards	4,694·8	4,944·3	+ 5·3	69,148·2	71,613·6	+ 3·6
Direct Supplies by Central Authority	185·0	208·7	+12·8	2,135·5	2,306·3	+ 8·0
Grand Total	4,879·8	5,153·0	+ 5·6	71,283·7	73,919·9	+ 3·7
Mainly Industrial Areas*	2,948·7	3,115·5	+ 5·7	43,045·8	44,613·1	+ 3·6
Mainly Non-Industrial Areas	1,746·1	1,828·8	+ 4·7	26,102·4	27,000·5	+ 3·4

* Those in which industrial consumers took over 50 per cent of the total sales in the preceding financial year.

Area Boards' Sales

In the accompanying table the electricity sales by Area Boards in August and for the last twelve months are detailed. The national figures show an increase over August, 1956, of 5·6 per cent, but, when corrected for weather conditions and working days, the increase is 7·6 per cent. The number of effective working days in August was 27·39 against 27·08 in the corresponding month last year.

Purchase Tax on Electric Kettles

The Southern Electricity Consultative Council is making further representations to the Chancellor of the Exchequer regarding the reason for the apparent purchase tax discrimina-

tion against electric kettles. It is felt that electric kettles are essential items of equipment in the kitchen equally with electric cookers, which do not bear purchase tax, and are more efficient and economical than the ordinary kettle used on an electric cooker.

Low Tide Stops Power Station

Owing to an abnormally low tide in the River Mersey on the morning of 25th September there was a failure in the cooling water supplies at Clarence Dock power station, Liverpool. The generators were out of action for nearly two hours. Engineers found that instead of water the pumps began sucking mud and air into the settling chamber, the tide being about 2½ft below the datum line. Because of overheating, the seven generators had to be switched out. Officials of the C.E.A. are making investigations to discover why the drying up of water supplies had never happened before and to prevent the chances of it recurring.

Additions to Hydro-Electric Schemes

Constructional scheme No. 47 published last week by the North of Scotland Hydro-Electric Board provides for additions to the existing schemes on the River Moriston in Inverness-shire and at Storr Lochs in Skye which will increase their output by a total of 13·5 million kWh a year.

In Glen Moriston the output of the Ceannacroc and Doe power stations will be increased by 12·2 million kWh by extending the catchment area feeding these two power stations to bring in waters from the Allt a' Chroinn, the Allt na' Muic and the Allt Bail 'an Tuim Bhuidhe, small burns on the north side of the Glen. Provision is also made for forming small reservoirs at Loch Liath, Loch na Stoc and Loch a' Chrathaich to improve the regulation of flow to the Livishie power station of the Moriston scheme. The Ceannacroc power station is already in commission but no work has yet been done on the Doe and Livishie power stations.

At Storr Lochs in Skye it is proposed to divert the headwaters of the River Chracaig into Loch Fada by the construction of two aqueducts. This would enable the Board to meet a request of the County Council of Inverness to release part of the yield from the Storr Springs for water supply purposes and also enable the Board to increase the output of electricity from the original scheme.

Supply in Belfast

Reviewing the year's results of the Belfast Corporation Electricity Department in his 1956-57 report, the city electrical engineer, Mr. R. P. Watson, B.A., B.A.I., M.I.E.E., says that the exceptionally mild weather reduced the expected rate of increase in demand by domestic consumers. The Department's hire and hire-purchase schemes for domestic equipment, however, continued to grow in popularity, almost 5,200 additional appliances being supplied to consumers during the year. Despite the strikes in the shipbuilding and engineering industries, electricity consumption by the shipyards showed a marked increase.

Sales to the various categories of consumers were as follows: General power, 231·5 million kWh (+5·8 per cent); domestic, 128·3 million kWh (+4·7 per cent); shipyards, 46·3 million kWh (+10 per cent); lighting, 30·1 million kWh (+7 per cent); and Transport Department, 28 million kWh (−3 per cent).

Nearly 10,800 new and additional supplies were connected to the system during the year, representing an estimated increase in connected load of 41,000 kW. At 31st March the total number of consumers was 146,730, an increase of 4,743. The Corporation has decided to convert street lighting completely from gas to electricity and it is hoped that the York Street, Royal Avenue and Donegall Place section, where fluorescent lighting is being installed, will be ready by Christmas.

The Corporation's East power station last year generated 341·7 million kWh and the West station 321·5 million kWh. Coal consumption amounted to 364,874 tons, the average price being 93s 3d a ton, as compared with 85s 1d in 1955-56.

Revenue amounted to £3,338,055 and the year's operations resulted in a gross profit of £587,298. After deducting capital charges there remained a net surplus of £75,581 to which is added a balance of £24,177 brought forward. It is proposed to allocate £26,094 to miscellaneous capital works and transfer £25,000 to the renewals fund. Capital expenditure last year amounted to £4,329,285, largely on the West power station extensions.

Commenting on the accounts, Mr. Watson says that during the current year it is unlikely that the revenue from even a substantial increase in electricity sales, coupled with greater overall efficiency in generation at the West station, will offset increased costs, and this matter is being kept under constant review.

Edinburgh Change-over Completed

The change-over from d.c. to a.c. in Edinburgh was completed last week when Lord Provost Johnson-Gilbert switched off the last d.c. generator at a ceremony in the McDonald Road station. Mr. C. H. A. Collyns, manager, Edinburgh and the Borders Area, said that the transformation had been expensive but would save some £50,000 a year in running costs. Mr. J. Henderson, the Board's chief engineer, referred to the growing size of electrical generating plant and in particular to the plan to increase the scope of the Kincardine station.

£21 Million C.E.A. Contracts

The Central Electricity Authority has placed contracts during the past month for power stations, transmission lines and transforming stations amounting in the aggregate to £21,274,000. They include a 100 MW set for Aberthaw power station and two 200 MW boilers for Willington "B." The principal contracts are as follows:—

Belvedere power station, near Erith: High pressure pipework and valves.—Aiton & Co.

Northfleet: Two reinforced concrete chimneys.—Tileman & Co.

West Thurrock: One turbo-alternator condensing and feed heating plant, two 22·5 MVA, 275/7·1 kV station transformers and one 210 MVA generator transformer.—C. A. Parsons & Co.

Willington "B," near Derby: Two 200 MW reheat boilers.—Babcock & Wilcox.

High Marnham, near Tuxford: Steelwork.—Dorman Long (Bridge & Engineering).

Staythorpe "B," Newark: One reinforced concrete cooling tower.—Davenport Engineering Co.

Aberthaw: One 100 MW turbo-generator, condensing and feed heating plants.—C. A. Parsons & Co. Pumphouse, circulating water tunnels and intake and outfall structures.—Edmund Nuttall & Sons & Co. (London).

Skelton Grange "B," Leeds: Ash and dust handling plant.—Babcock & Wilcox.

Sunderland substation: 66 kV, 20 kV and 5·25 kV cables.—Pirelli-General Cable Works.

St. Helens substation: 132 kV switchgear.—Ferguson Pailin.

Newton Abbot substation: 33 kV switchgear.—British Thomson-Houston Co.

Belvedere substation: Two 90 MVA, 132 kV reactors.—English Electric Co.

Wold Newton substation: Two 45 MVA, 132/33 kV transformers.—C. A. Parsons & Co.

Warrington substation: Two 60 MVA, 132/33 kV transformers.—Ferranti.

Boston substation: Two 45 MVA, 132/33 kV transformers.—Ferranti.

Kirkley substation: Two 120 MVA, 275/132 kV transformers.—Metropolitan-Vickers Electrical Co.

Speke substation: Two 60 MVA, 132/33 kV transformers.—Metropolitan-Vickers.

Tilbury substation: 275 kV and 132 kV switchgear.—Metropolitan-Vickers.

Gloucester substation: 132 kV switchgear.—Metropolitan-Vickers.

Bold "B" substation: 132 kV switchgear.—English Electric Co.

Liskeard substation: Two 45 MVA, 132/33 kV transformers.—British Thomson-Houston Co.

Berkeley substation: 132 kV switchgear.—British Thomson-Houston Co.

Bracknell-Fleet: 132 kV twin overhead line.—W. T. Henley's Telegraph Works Co.

Harker-Penwortham: 275 kV twin overhead line.—W. T. Henley's Telegraph Works Co.

Rugeley-Chase Terrace-Willenhall: 275/132 kV overhead line.—Balfour Beatty & Co.

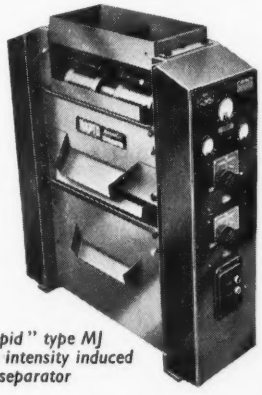
NEW ELECTRICAL EQUIPMENT

Induced Roll Separator

A high intensity, induced roll separator which provides the necessary magnetic field for the purification of free flowing granular materials has recently been introduced by RAPID MAGNETIC MACHINES, LTD., Lombard Street, Birmingham, 12. The basic unit has a 5in diameter roll, with two parallel 5in feed widths. Several such units can be fitted together to provide a separator with any number of rolls for difficult separations, or where selective separation of different materials is required.

The equipment is particularly applicable for the purification of such items as silica sand, abrasive grain, corundum, graphite, kyanite and slag. This is dependent upon the material size and magnetic susceptibility, but typical figures are 1½ tons/hr for the purification of silica sands.

The equipment is fitted with sealed bearings throughout and every part of the separator is either removable or readily accessible. Each magnetic coil is rheostatically controlled, thus allowing variation of energy at each roll.



"Rapid" type MJ high intensity induced roll separator

Floatless Liquid Level Control

A new floatless liquid level control is now available for a wide range of industrial applications where it is necessary to control the level of liquid in boilers, tanks, or other vessels, from MEYNELL & SONS, LTD., Montrose Street, Wolverhampton. The level control has been designed for use in conjunction with electrically driven pumps and incorporates the Teddington patented liquid level switch. The unit is eminently suitable for steam boiler applications where it can be used for feed water pump control and/or a low water alarm and cut-out.

The company is at present manufacturing two models. The Mark III WX/AD/1 type is suitable for controlling the water level of steam boilers having a maximum steam working pressure of 120 p.s.i. and the control of non-corrosive fluids at or near atmospheric temperature at a maximum working pressure of 350 p.s.i. The liquid level in many applications can normally be controlled to within approximately ½in, this factor, however, being dependent on the rate of liquid efflux. The switch will operate in 8-12 sec of level change. The level control covers a wide temperature range from just above freezing point (providing freezing point is not lower than − 22 deg F) to 350 deg F.

The Mark III/WX/AE/1 model is available for use where a rapid restoration of level is not considered essential or is not required at all. The switch in this case will operate in 32-38 sec of level change. This model is not recommended for use with steam or where the maximum temperature exceeds 250 deg F.

The unit is floatless in both models and has no moving parts. Normal blow-down of the unit is necessary when it is used for steam boiler operation but apart from this no maintenance is required.

Impact Wrench

The "Hicycle" 7250 impact wrench introduced by the CONSOLIDATED PNEUMATIC TOOL CO. of 232, Dawes Road, London, S.W.6, is designed for use on ⅜in to ⅝in bolt sizes and has a number of refinements such as an easily attachable angle head, safety reversing switch and a natural balance which makes it effortless to hold and increases its spotting accuracy.

"Hicycle" impact wrench

The tool operates on a three-phase circuit of 200 c/s at 125 V. An adjustable deflector for directing cooling air away from the operator is incorporated and a safety reversing switch prevents accidental reversing while the wrench is running. This switch has a one finger control, so that there is no need to use the other hand to reverse the wrench.

Among the additional equipment which may be supplied are an angle head attachment and a tray of six sockets for ½in square drives, hexagonal sockets being supplied for ⅜, ½, $\frac{7}{16}$, ½ and $\frac{9}{16}$in B.S.F. and new standard Whitworth. A further attachment is a universal joint for ½in drive at each end; when supplied as a car tyre kit, a 5in extension bar is also included. All the attachments and wrench are readily stowed in a metal box with carrying handle.

Damping-Constant Measurement

The damping constants of a material provide an extremely sensitive indication of the condition of the internal structure, presence of non-homogeneity, existence of flaws, etc. The type LDA equipment, recently developed by A. E. CAWKELL, ELECTRONIC ENGINEERS, 6-8, Victory Arcade, The Broadway, Southall, Middx., provides an application of the principle in a compact and easily usable form.

Normally one of these units is the variable frequency oscillator type OSP36 which, connected to one of the transducers, is used to excite the specimen, by varying the frequency until a resonant condition is achieved. Alternatively, if the user possesses a Cawkell SCT electrodynamic testing instrument, a blank panel replaces the OSP36, and the SCT oscillator is used to excite the specimen, a connection being made to that instrument with the plug and socket fitted.

The other two panels and chassis contain the amplifiers, voltage comparators, counting circuits, and the stabilised power supply. The instrument receives from the pickup transducer voltages derived from the vibrating specimen. The drive oscillator is then cut off at the source, and the decaying voltage due to the damping out of the mechanical vibrations is applied to the comparator-counter. At a certain voltage a "gate" is opened and the oscillations are permitted to operate a counter consisting of four "Dekatrons." When oscillations have decayed to a predetermined level, counting ceases. The number of cycles during the "gate open" interval, up to a maximum of 9999, is read from the Dekatrons. The instrument is arranged such that: $D=\log_e 2/N$ where N=number shown on counter as $Q=11/D$

$Q=4{\cdot}5N$ (approx.)

The equipment is therefore capable of measuring Q's of up to 44,995; instrumental accuracy is better than 2 per cent.

Cawkell type LDA instrument

Financial Section

STOCKS and SHARES

IN the Stock Exchange, some progress has been made towards finding at least a temporary level of prices appropriate to the 7 per cent Bank Rate and to the measures accompanying it. In the gilt-edged market there was a partial recovery from the initial reaction to the decisions. With the volume of investment business falling away to small dimensions, the atmosphere in the industrial market had become generally calmer, although still very uncertain, by the beginning of this week. Government stocks have been following closely the course of the exchange rates of the pound. Ordinary shares have been tending in turn to take their lead from the gilt-edged market, but with an eye also, of course, to the probable consequences of the new measures in the industrial field.

Price Movements

Shares of the major electrical groups have offered resistance in some instances to the previous week's plunge of prices. English Electric, for instance, recovered 2s 6d of the earlier fall of 7s 6d. A.E.I. were showing little further change at the beginning of this week. Movements in G.E.C. have been relatively narrow during the period of disturbance, and Crompton Parkinson behaved with noticeable steadiness throughout. Further falls in Parsons and Reyrolle seemed to reflect a cautious attitude towards shares quoted on a low present yield basis. This would account also for the flatness of shares such as Head Wrightson and Clarke Chapman; the latter have fallen by more than 30s in the past fortnight, and at 130s now stand 50s below the best prices recorded earlier this year. Chloride Electrical and Automatic Telephone were also among those to be marked down again. Recoveries ranging from a few pence to two shillings have been fairly plentiful, however, benefiting among others Thorn Electrical, Decca, B.I.C.C. and Hoover.

Pye Meeting

As previously known from the annual report, a main factor in the reduction of the Pye group's earnings in 1956–57 from £2·3 to £1·7 million (before tax) was the contraction of profit margins through rises in wages and other costs, which were not passed on to the consumer. At the general meeting Mr. C. O. Stanley told shareholders that an increase in prices was planned in the New Year, which was hoped to have favourable effects upon the trading results of the last quarter of the financial year. Referring to the increase in the group's bank loans, totalling nearly £3¼ million in the balance-sheet, the chairman said that the intention was to replace part of these with a more permanent form of finance when a suitable opportunity presented itself.

Non-Voting Shares

At the Pye meeting, approval was given to an increase in the authorised capital by 2·8 million "A" deferred

Price Changes in

Company or Board	Nom. Value	Middle price 30th Sept.	Week's Rise or Fall	Dividend Previous	Dividend Last	Yield %	1957 Highest	1957 Lowest
Gilt-edged Stocks						£ s d		
Brit. Elec. 1968/73	100	71	+⅜	3	3	4 4 6	80	70
Brit. Elec. 1974/77	100	67		3	3	4 9 6	78½	66
Brit. Elec. 1976/79	100	71		3½	3½*	4 18 6	81½	70½
Brit. Elec. 1974/79	100	80		4½	4½	5 6 3	92½	79½
Overseas Electric Supply								
Calcutta Elec.	£1	17/6		6†	6·8†	7 15 6†	19/-	15/-
East African Power	£1	19/6	−1/-	7	7½	7 13 9	21/-	19/-
Nigerian Elec.	£1	17/6		10	10	11 8 6	18/6	17/3
Perak Hydro-Elec.	£1	16/3		10	10*	12 6 0	18/-	13/3
Electrical Shares								
Aberdare Cables	5/-	11/9	+6d	17½	17½	7 9 0	12/6	9/9
Aerialite	1/-	5/9		45	48	8 7 6	6/9	4/9
Allen, W. H.	£1	45/6		10	10	4 8 0	47/3	33/6
Anglo-Portuguese Tel.	£1	23/-		8	8	6 19 3	27/6	20/6
Aron Elec. Ord.	£1	58/9		15	15	5 2 3	60/-	53/6
Assd. Automation	10/-	18/6	−3d	5	7½	4 1 0	24/9	17/9
Assoc. Elec. Ord.	£1	55/-		15	15	5 9 0	73/-	55/-
Automatic Tel. & El.	£1	65/-	−3/9	15	17	5 4 6	75/-	54/6
Babcock & Wilcox	£1	63/9	+1/3	15	15	4 14 0	82/6	60/-
Bakelite	10/-	22/9		16	15	6 11 9	24/6	20/9
Baldwin, H. J.	2/-	4/6		20	20	8 17 9	5/-	3/10½
Berry's Electric	5/-	6/3	+3d	—	10	8 0 0	6/6	5/6
British Aluminium	£1	50/-	+1/3	12	12	4 16 0	71/3	48/9
Brit. Elec. Traction: Def. Ord. "A"	5/-	21/9	+1/-	22½	25	5 15 0	25/-	17/-
B.I. Callender's	£1	43/9	+1/6	12½	12½	5 14 3	55/-	42/3
B.I. Callender's 6% Pref. ...	£1	19/-		6	6	6 6 3	21/9	19/-
British Tabulating...	£1	40/6	−2/-	9	9	4 9 0	56/3	40/6
British Thermostat	5/-	23/9		25	25	5 5 3	27/6	23/9
British Vac. Cleaner	5/-	5/-	−6d	15	10	10 0 0	8/-	5/6
Brook Motors	10/-	36/3		25	25	6 18 0	37/6	30/-
Bulgin, A. F.	1/-	4/3	+3d	50	40*	9 8 6	5/6	4/-
Burco Dean	5/-	12/3	+3d	22½	20	8 3 3	14/-	8/9
Cable & Wireless: Ord.	5/-	10/6	−3d	10	10	4 15 3	12/6	9/6
4% Loan	100	91½		4	4	4 7 6	92½	89
Chloride El. Storage "A" ...	£1	58/9	−3/3	17½	17½	5 19 3	68/9	58/-
Clarke Chapman	£1	130/-	−10/-	22½	27½	4 4 6	9	6½
Cole, E. K.	5/-	18/9	+1/3	17½	17½	4 13 4	23/6	16/6
Cossor, A. C.	5/-	5/6	−3d	Nil	2½	2 5 6	7/3	5/6
Crabtree	10/-	23/9	+3d	20	20	8 8 6	26/-	23/3
Crompton Parkinson Ord. ...	5/-	16/6		16	16	4 17 0	17/9	14/6
De La Rue	5/-	23/6	+3d	30	35	7 9 0	24/9	16/3
Decca "A"	4/-	25/9	+2/-	43¾	43¾	6 16 0	32/3	23/9
Desoutter	5/-	34/6		30	32½	4 14 3	35/6	27/6
Dewhurst	2/-	6/6		30	16½*	5 0 0	7/9	5/9
Dictograph Tel.	2/-	5/6		20	20	—	6/3	5/6
Dubilier Condenser	1/-	3/9	+3d	30	30	—	5/-	3/6
Duport	5/-	18/-	−2/-	23	25	6 19 0	21/-	17/6
E.M.I.	10/-	30/-	−9d	15	15	5 0 0	36/-	23/9
Electrical Components	5/-	7/6		25	12½*	8 6 9	8/-	6/6
Elec. Construction	£1	23/9		8½	8½	7 3 3	27/6	21/9
Elliott Bros.	5/-	23/9	−2/6	17½	20	4 4 3	33/6	23/9
Enfield Cable Ord.	£1	15/-		Nil	Nil	Nil	21/6	13/-
English Electric	£1	55/-	+2/6	12½	14	5 1 9	65/-	47/6
English Electric 3¾% Pref. ...	£1	11/3		3¾	3¾	6 13 3	14/3	11/3
Ericsson Tel.	5/-	40/-	−2/3	20†	22†	2 15 0†	50/-	33/3
Ever Ready	5/-	17/3	+1/6	35	37½	5 8 9*	20/-	15/-
Falk Stadelmann	£1	37/-		17½	17½	9 9 3	40/6	35/-

The above quotations are based upon middle prices in the Stock Exchange Daily Official List.
* After scrip issue. † Free of income tax. ‡ Dividend indicated.

shares. In referring to this form of capital, which carries no voting rights, the chairman touched on a topic which has lately returned much to the fore in investment circles. The past few years have seen the creation of very large amounts of such capital, the holders of which have no (or only a restricted) say in their companies' affairs. Recently some investment trusts and insurance companies have shown growing opposition to the tendency, and the Stock Exchange Council has expressed disfavour of non-voting shares in principle. Mr. Stanley explained the Pye company's policy in this respect by reference to the importance of preventing control of the company from passing into the hands of any group that might upset continuity of management during the years of expansion. The position is to be reviewed by the company.

Electrical Investments

Company or Board	Nom. Value	Middle price 30th Sept.	Week's Rise or Fall	Dividend Previous	Dividend Last	Yield % £ s d	1957 Highest	1957 Lowest
Electrical Shares—continued								
G.E.C. Ord.	£1	45/-	+1/3	14	12½	5 11 0	58/9	43/9
G.E.C. 6½ Pref.	£1	20/-	+6d	6½	6½	6 10 0	23/6	19/6
General Cables	5/-	13/-	−2/-	30	30	11 10 9	15/6	11/6
Greenwood & Batley	£1	50/-		17½	17½	7 0 0	50/-	45/3
Hackbridge Holdings	5/-	13/9	+1/9	30	20	7 5 6	21/9	12/-
Hackbridge & Hewittic	5/-	11/3		23	20	8 17 9	16/-	11/3
Head Wrightson	£1	122/6	−3/9	20	22½	3 13 6	146/3	112/6
Heatrae	2/-	4/9		15	15	6 6 6	4/9	4/-
Henley's	10/-	14/-		11½	11½	8 4 3	17/-	14/-
Holophane	5/-	22/-*		30	30	6 16 3	26/3	17/-
Hoover	5/-	35/-	+3/9	50	50	7 2 9	44/-	24/9
I.C.I.	£1	41/-	+2/-	10	10	4 17 6	46/6	37/9
Intl. Combustion	5/-	22/-	−1/-	20	22½	5 2 3	30/-	20/-
Johnson & Phillips	£1	23/3		15	10	8 12 0	34/6	23/3
Lancashire Dynamo	£1	38/9	+1/3	11	11	5 13 6	45/-	36/9
Laurence, Scott	5/-	15/9	−6d	15	15	4 15 3	19/9	13/9
Lister, R. A.	£1	28/3	−6d	10	10	7 1 6	33/9	26/9
London Elec. Wire	£1	43/9		12½	12½	5 14 3	53/9	43/-
Lucas, J.	£1	30/-	+1/3	7½	7½	5 0 0	36/6	28/9
Marconi Marine	£1	33/9	−1/3	10	10	5 18 6	37/-	31/-
Marryat & Scott	2/-	12/3		30	35	5 14 3	13/-	8/-
Mather & Platt	£1	53/9	−4/6	15	15	5 11 6	63/9	51/3
Metal Industries	£1	26/3	+9d	Nil	9	6 17 3	30/-	20/3
Midland Elec. Mfg.	£1	48/9	−1/3	12½	12½	5 2 6	52/6	45/-
Morphy-Richards	4/-	16/3		50	50	4 18 6*	20/-	11/9
Murex	£1	62/6	−4/3	20	20	6 8 0	79/6	65/-
Newman Ind.	2/-	2/9		10	10	7 5 6	2/9	2/1
Oldham & Son	1/-	2/9		17½	17½	6 7 3	3/-	2/3
Parnall (Yate)	5/-	6/6	−3d	12	12	9 4 6	8/9	5/9
Parsons, C. A.	£1	51/3	−6/3	8½	7½*‡	—	71/3	50/6
Plessey	10/-	66/3		27½	30	4 10 6	86/3	61/-
Pye "A" Deferred	5/-	13/3		12½	12½	4 14 3	20/-	13/3
Reyrolle	£1	80/-	−5/-	16½	17½	4 7 6	110/-	80/-
Rheostatic	4/-	7/6	−1/3	18½	12½*	6 13 3	10/-	7/6
Richardsons Westgarth	5/-	15/6	−6d	16⅝	16⅝	5 7 6	20/-	15/6
Scottish Cables	4/-	16/9	−6d	27½	27½	6 11 3	19/3	15/-
Simon-Carves	5/-	28/9		28½	20*	3 9 6	36/3	26/-
Smith (England), S.	4/-	13/9	−9d	17½	17½	5 1 9	15/9	13/-
Southern Areas	£1	12/6		7½	7½	12 0 0	20/-	12/6
Strand Elec.	5/-	6/9		15	15	11 2 3	8/-	6/9
Sturtevant	5/-	22/3	−6d	15†	15†	3 7 6†	27/-	22/3
Sun Elec.	£1	43/9		20	25	11 8 6	43/9	43/9
Switchgear & Cowans	5/-	11/3	−1/9	25	25	11 2 3	15/6	11/3
Taylor Tunnicliff	5/-	12/3	+6d	15	15	6 2 6	13/9	11/9
T.C.C.	10/-	41/3		25	25	6 1 3	41/3	35/-
T.C. & M.	£1	25/-	+6d	8½	8½	6 12 0	31/-	24/6
Telephone Mfg.	5/-	5/6		10	10	9 1 9	8/-	5/6
Telephone Rentals	5/-	10/6		12½	12½	5 19 0	12/6	10/3
Thompson (John)	5/-	27/6	+6d	25	25	4 11 0	37/-	27/-
Thorn Elec.	5/-	21/3	+2/6	15	17½	4 2 3	26/3	16/3
Thornycroft	£1	25/-	−1/3	15	12½	10 0 0	37/6	25/-
Tube Investments	£1	60/-	−1/3	22½	15*‡	5 0 0	70/-	58/3
Vactric	5/-	18/3	−6d	17½	25	6 17 0	23/9	12/9
Veritys	5/-	8/6		12½	12½	7 7 0	9/3	8/-
Walsall Conduits	4/-	12/3	−6d	20	20	6 10 6	15/-	11/-
Ward & Goldstone	5/-	24/-	−2/3	35	40	4 3 3*	29/-	18/6
Watford	2/-	6/6		25	25	7 13 9	6/9	6/3
Westinghouse	£1	31/3	−1/3	18	9‡	5 15 3	41/3	32/6
West, Allen	5/-	10/9	−6d	15	15	—	13/6	9/6
Wolf Electric	5/-	10/6		20	20	4 15 3*	13/9	8/9

I.C.I. Half-Year

An interim report from Imperial Chemical Industries covering the first six months of this year had a good reception in the market. Having moved up to 42s, the £1 shares are among the very few to have fully maintained their value during the recent disturbances. While sales of the group, in comparison with the same half of 1956, rose by 6 per cent to £235 million, the net profits (after allowing for tax and depreciation) expanded more than proportionately to the extent of some 16 per cent. For this improvement the company's statement gives credit to the heavy capital expenditure of recent years. It adds that since the middle of the year there has been no marked change in general trading conditions.

Interim Dividends

In raising the interim dividend on account of the current year from 3 to 5 per cent, the Telephone & General Trust advise shareholders that this should not be taken to imply an increase in the total for the year. For 1956 there was a final payment of 10 per cent and the total of 13 per cent was covered two and a half times over by profits available. At 49s, the £1 shares show a yield of about 5¼ per cent on that basis. Switchgear & Cowans are reducing this year's interim dividend from 10 to 7½ per cent, profits having been affected by the strikes which took place in March and by higher costs resulting from increased wages. For each of the two previous years the company paid dividends totalling 25 per cent.

Preference and Debentures

In the market for high-grade preference shares, the tendency is for yields to find a level about one per cent above the return on War Loan, now a little under 5¾ per cent. Of the three Ferranti preference issues, for instance, the senior 7 per cent shares at 21s 6d yield a fraction over 6½ per cent; the 5 per cent second issue, at 14s 9d, about 6¾ per cent; and the 5½ per cent third issue, at 15s 9d, nearly 7 per cent. Among unsecured loan stocks, the G.E.C. 6 per cent issue, redeemable 1976–81, could be bought recently at a point below par, and the Telegraph Construction 5¾ per cent loan 1974–76 at 96, to yield approximately 6 per cent each share. Returns of a shilling or two under 6 per cent are offered on first-class debentures such as the English Electric 5½ per cent stock, redeemable 1977–82, which has been available at 93½.

REPORTS and DIVIDENDS

Pye, Ltd.—Addressing shareholders at the annual meeting held on 25th September, Mr. C. O. Stanley (chairman and managing director) said that during the first six months of the current year they enjoyed an increase in turnover for the group. As they had not yet increased their prices for home television and radio sets there was no improvement in the margin of profit. They had planned to make an advance in prices in the New Year and they hoped this would favourably affect the last three months' trading of the current financial year. All the subsidiary and associated companies overseas had made progress, as had also the subsidiary companies at home. After mentioning the wide fields covered by these companies, Mr. Stanley referred to the proposal to increase the authorised capital by the creation of further "A" deferred ordinary shares. Some of the shareholders expressed the opinion, regarding the proposed new issue of "A" shares, that these should have some voting rights, and it was the board's intention to examine the situation in detail. The last two years had seen a marked increase in the bank overdraft, and the directors intended to replace part of this by more permanent finance when a suitable opportunity presented itself. The incidence of high taxation precluded a rapidly expanding business such as theirs from financing itself effectively out of retainable profits.

Switchgear & Cowans, Ltd., announce an interim dividend of 7½ per cent (against 10 per cent) on larger capital. The directors report lower trading profits for the first half-year of 1957 due to the shipbuilding and engineering unions' strike in March and to the inability to recover on orders in hand the higher costs arising from increased wages.

James Howden & Co., Ltd.—The Charterhouse Finance Corporation announces that in the recent issue to shareholders of 546,000 ordinary shares of 10s each at 40s per share, 538,195 shares representing 98·5 per cent of the total were accepted by way of rights. This left 7,805 shares available to meet applications for over 155,000 additional shares from 587 applicants. These have been scaled down.

The Telephone & General Trust, Ltd., is paying an interim dividend of 5 per cent (against 3 per cent) on increased capital. It is stated that the higher interim dividend does not imply an increased total dividend for the current year.

Relay Exchanges, Ltd., has declared an interim dividend of 15 per cent (against 12½ per cent). The directors state that the increase should not be regarded as implying that there will be an increase in the rate of the final dividend. However, the profits on trading for the first half of the year show an increase over the corresponding period of 1956, and it is anticipated that improvement will continue as expansion of the business is proceeding in accordance with the planned development.

The Superheater Co., Ltd., is paying an unchanged interim dividend of 10 per cent. In making the announcement, the directors state that for the first eight months of the year output exceeded that for the corresponding period of last year. Exports and earnings showed an increase. While the value of new orders booked in this period was less than a year ago, it was in excess of output.

The Palestine Electric Corporation, Ltd., reports a profit for the year to 31st March last of I£78,460, as compared with I£292,816 for the preceding fifteen months. There is no United Kingdom taxation charged for the past year, but for the preceding fifteen months the profit was after providing I£1,350,000 for taxation. No dividend (as before) is recommended on the ordinary and "A" ordinary capital.

W. T. Henley's Telegraph Works Co., Ltd., is paying an interim dividend of 2½ per cent (unchanged).

The British Aluminium Co., Ltd., has declared an interim dividend of 4 per cent (unchanged).

The Sturtevant Engineering Co., Ltd., is maintaining its interim dividend at 3 per cent, tax free.

The London Electric Wire Co. & Smiths, Ltd., has declared an interim dividend of 3¾ per cent (unchanged).

New Companies

Kenville Jackson (Southern), Ltd.—Registered 20th August. Capital £100. Manufacturers of and dealers in electrical goods of all kinds, etc. Directors: Kenville G. N. Jackson and Shirley A. Jackson (secretary). Regd. office: 1, West Gate, Town Centre, Harlow.

Industrial Refrigeration Co., Ltd.—Registered 19th August. Capital £100. Manufacturers of and dealers in refrigerators, cold storage machinery, etc. First directors: R. K. Tebbs, G. F. Crook and D. Rogers. Regd. office: 92, New Cavendish Street, London, W.1.

Taylor & Badger, Ltd.—Registered 20th August. Capital £1,000. Light engineers, atomic, electronic, electrical and general engineers, etc. Directors: H. D. Badger (secretary) and J. Taylor. Regd. office: Speciality Works, Masbrough Street, Rotherham.

Gatwick Electronics, Ltd.—Registered 16th August. Capital £100. Manufacturers of electronic, electrical and other instruments and appliances, etc. Directors: G. W. Pay, R. B. Pegler and P. Inker. Solicitors: Keene, Marsland & Co., 52, Mark Lane, London, E.C.3.

Mansfield Television and Radio Services, Ltd.—Registered 11th September. Capital £1,000. To acquire the business of manufacturers of and dealers in radio, television, gramophones and electrical equipment carried on by Mansfield Television and Radio Services at Mansfield, Notts, etc. Directors: H. Lewis, R. J. Wright, C. W. Clifford and E. W. Cook. Regd. office. 20, White Hart Street, Mansfield.

Centrum Electronics, Ltd.—Registered 13th September. Capital £500. Importers, exporters and manufacturers of and dealers in electrical, electronic and radio equipment and apparatus, etc. Solicitors: Reynolds, Gorst and Porter, 7, Arundel Street, W.C.2.

Alexander & Tatham, Ltd.—Registered 17th September. Capital £100. Dealers in and manufacturers of electronic control instruments, etc. Directors: W. Alexander, Margaret P. Alexander and Patricia E. Tatham. Regd. office: Victoria Chambers, South Parade, Leeds, 1.

Sidren Electrics, Ltd.—Registered 17th September. Capital £1,000. To acquire the business hitherto carried on as Sidren Electrics as retailers and repairers of and dealers in radio and television equipment, electrical equipment, etc. Directors: S. Nathan and Rene Nathan. Regd. office: 147, High Road, Streatham, S.W.16.

Bacon & Spragg, Ltd.—Registered 17th September. Capital £1,000. Radio and television engineers, etc. Directors: J. Spragg and A. Bacon. Regd. office: 90, Outram Street, Sutton-in-Ashfield, Notts.

Blackham Brothers, Ltd.—Registered 19th August. Capital £3,000. Manufacturers and repairers of and dealers in radio and television sets, etc. Directors: J. H. Blackham (secretary) and A. E. Blackham. Regd. office: 157, New Road, Rubery, Birmingham.

Tennent & Craigie, Ltd.—Registered in Edinburgh 31st May. Capital £2,000. Electrical, refrigerating, ventilating and consulting engineers, etc. Directors: P. M. Tennent and L. A. C. Craigie. Regd. office: 53, Low Glencairn Street, Kilmarnock.

P. J. J. Colborne, Ltd.—Registered 27th August. Capital £1,000. To acquire the business of a manufacturing, electrical and mechanical engineer carried on by Paul J. J. Colborne at Plumstead, S.E., etc. P. J. J. Colborne is the first director. Regd. office: 28, Plumstead High Street, S.E.

Enfields (Keynsham), Ltd.—Registered 26th August. Capital £10,000. Designers, manufacturers of and dealers in radio, television and telephone apparatus, etc. Directors: H. E. Enfield, C. E. Enfield and Mrs. Sylvia J. Enfield. Regd. office: 66, High Street, Keynsham, Som.

J. McFarlane (Hull), Ltd.—Registered 27th August. Capital £100. To acquire the business of a television and radio engineer carried on by J. McFarlane at Hull. Directors: J. McFarlane and Mrs. Kathleen M. McFarlane. Regd. office: 52a, Beverley Road, Hull.

Bankruptcies

L. Bloom, formerly carrying on business in partnership with another under the style of Bloom Bros., at 12, Duke Street St. James's, London, electrical engineers.—Supplemental dividend of 1s 8¾d in the £, payable from to-day (Friday) at Bankruptcy Buildings, Carey Street, London, W.C.2.

W. J. K. Incledon, lately carrying on business at 203, West Derby Road, Liverpool, electrical engineer.—First and final dividend of 1s 2½d in the £, payable on and after 10th October at the offices of Parkin S. Booth & Co., 5, Rumford Place, Liverpool, 3.

E. Webb, lately carrying on business at 10, Alderley Street, Macclesfield, Ches., as an agent for electrical appliances.—Public examination 12th November at the Town Hall, Macclesfield.

E. W. White, 5, Greenfield Road, Southmead, Bristol, electrical contractor.—Trustee, Mr. P. W. Hort, 28, Baldwin Street, Bristol, 1, released 18th September.

Liquidation

Pentlyke Electrical Co., Ltd.—Winding up voluntarily. Liquidator, Mr. J. N. Prentice, 5, London Wall Buildings, Finsbury Circus, London, E.C.2.

PORTUGUESE ELECTRICAL IMPORTS

Predominance of Western Germany and United Kingdom

DURING last year West Germany managed to maintain its lead as Portugal's principal supplier of electrical goods. Table 1 shows the main suppliers during 1955 compared with last year. (£1=80 escudos.)

Table 1.—Portuguese Electrical Imports (thousand escudos)

Country	1956	1955
United Kingdom	5,082	4,075
West Germany	6,237	5,125
France	1,581	1,567
Holland	1,482	1,548
Switzerland	1,351	1,094
Sweden	813	475
United States	706	1,119
Belgium	529	317
Italy	393	187
Total, including others	18,312	15,821

Table 2 shows imports by classes. While imports from United States and Holland decreased, the Swiss and French electrical industries successfully penetrated the market particularly with power plant. Table 3 sets out the United Kingdom's principal electrical exports to Portugal and shows the predominance of telecommunication equipment. West German and American radio receiving and transmitting equipment are among the predominant products of these countries.

The lack of fuel in Portugal necessitates the production of electricity mainly by water-power stations; steam plants come into production only at peak times. The Nuclear Energy Commission (Junta de Energia Nuclear) is engaged in prospecting uranium sites locally and in educating scientists and engineers in the application of nuclear energy in connection with power projects. It is anticipated that Portugal within the next ten years will install a 100 MW nuclear power plant.

The Government has decided to sponsor four more major hydro-electric projects not included in the present development plan. A further 485 million escudos has been allocated for this purpose. The schemes are:—Miranda do Douro, Bemposta (River Douro); Alto Rabagao (River Cavado); and Vilar and Tabuaco (River Tavora).

Another organisation recently set up is the National Institute of Industrial Research (Instituto Nacional de Investigacao Industrial) within the framework of the Ministry of Economics. The objects of this Institute are to promote, help and co-ordinate research for the purpose of developing and improving the industry of the country. It is empowered to call in the services of national or foreign individuals and organisations to assist. Funds are allocated from the national budget, either directly or through State organisations who call on their services, apart from grants from local authorities.

Portugal has its own small but rigidly protected electrical industry manufacturing motors, transformers, meters and cables. Exports were valued at £261,000 in 1955 and £451,000 last year and went mainly to Portuguese overseas possessions.

Table 2.—Principal Electrical Imports, 1956 (thousand escudos)

Class	Value	Class	Value	Class	Value
Generators up to 100 kg	4,057	Vacuum cleaners	6,115	Cables and flex, insulated, without metal armour or sheath, textile, fabric or yarn covered	2,503
Ditto, 100–500 kg	1,545	Floor polishers	3,681	Cables, bare	9,255
Alternators	2,230	Flat irons	5,411	Ditto, metal armoured or sheathed, whether or not covered with other materials	23,715
Motors, up to 100 kg, except 3-phase	6,783	Refrigerating chests, show cases and the like	45,969	Wire, enamelled	45,161
Ditto, 100–500 kg, except 3-phase	473	Household meters	6,767	Ditto, asbestos covered, or with asbestos and textile thread	5,932
Motors, 3-phase, synchronous, up to 50 kg	2,462	Accumulators, lead type	3,886	Ditto, n.e.s.	2,424
Ditto, 50–500 kg	6,428	Ditto, others	2,840	Filament lamps	10,964
Convertors, rotating, up to 100 kg	3,604	Batteries, dry	2,192	Other lamps	4,633
Ditto, 100–500 kg	1,331	Radio receivers, apparatus for telegraphy, telephony and TV, power amplifiers, sound recorders	78,776	Insulating materials	2,560
Transformers up to 500 kg	14,352	Electronic valves	6,464	Articles of insulating material (ceramic or glass) for electrical appliances as fuses, lamp brackets, insulators, etc., with or without metal fittings	10,900
Ditto, 500–5,000 kg	5,065	Telephone exchanges, complete (mainly from U.K.)	64,533	Ditto, n.e.s.	20,714
Switches, automatic, and cut-outs	19,883	Private telephone installations up to 50 lines	172		
Switches, non-automatic, interrupters and rheostats	5,089	Telephone relays (mainly from U.K.)	2,414		
Power distribution boards, complete	9,645	Heating elements	957		
Condensers	7,160				
Dish washers	354				
Washing machines	4,376				

Table 3.—Principal United Kingdom Electrical Exports to Portugal (£000)

Class	1956	1955
Generating sets, generators and motors	135	128
Converting machinery, mercury arc rectifiers, transformers, switchgear and switchboards	51	115
Electronic valves, radio, TV, radar and sound reproducing apparatus	445	216
Telegraph and telephone equipment, line apparatus	883	1,017
Cables, wires, strips and strands, insulated	269	234

Overseas Students at I.E.E.

MORE than 160 students from 31 overseas countries were entertained at the Institution of Electrical Engineers, London, on 27th September. They were Athlone Fellows from Canada and F.B.I. Scholars from the Dominions and other countries, and some private students sent by their companies to study in England. They spend a couple of years here on post-graduate work at several of our universities and industrial concerns.

After a reception in the library by the President, Sir Gordon Radley, the students were welcomed in the lecture theatre by Mr. S. E. Goodall, M.Sc.(Eng.) (vice-president), who explained that they would see the outstanding engineering achievements of the profession and some of the early stages of developments now taking place. The Institution, he said, had taken a lively interest in the education of potential engineers, and they were anxious that the students should regard the Institution as of interest and service to them. They would be welcome at all lectures.

Mr. F. L. Fielding, chairman of the London Graduate and Student Section Committee, added his welcome and said that as he was a New Zealander they might think there was a prejudice in favour of overseas students. There was!

The students were shown the film "Mirror in the Sky," the story of the Heaviside and Appleton Layers, and a number of exhibits including a model of the Berkeley nuclear power station, locomotive models, etc., as well as early printed books and Faraday manuscripts.

NEW PATENTS

Electrical Specifications Recently Published

The numbers under which the specifications will be printed and abridged are given in parentheses. Copies of any specification (3s 6d each including postage) will be obtainable after 9th October from the Patent Office, 25, Southampton Buildings, London, W.C.2

1952

26013. Young, S. G.—Shutters for electrical socket outlets. 15th January, 1954. (784498.)

1953

32298. Yardney International Corporation.—Electrodes for electric batteries. 20th November, 1953. (784395.)

32935. Birlec, Ltd.—Electrical timing devices. 29th November, 1954. (784507.)

1954

6329. Heron, A. G.—Electrically operated compression refrigeration apparatus. 22nd April, 1955. (784509.)

9162. British Telecommunications Research, Ltd.—Magnetic recording equipment. 17th March, 1955. (784571.)

9572. International Business Machines Corporation.—Electronic commutator. 1st April, 1954. (784513.)

11413. Compagnie Générale de Télégraphie sans Fil.—Electronic switches. 20th April, 1954. (784515.)

17612. Bristol Aircraft, Ltd.—Electrical phasemeters and torquemeters. 25th August, 1955. (784582.)

19160. United Kingdom Atomic Energy Authority.—Nuclear reactors. 29th April, 1955. (784291.)

19161. United Kingdom Atomic Energy Authority.—Moderator structures for nuclear reactors. 29th April, 1955. (784292.)

19436. Beck's Inc.—Electric circuits and methods of making same. 2nd July, 1954. (784516.)

19899. General Electric Co., Ltd.—Electric motor control systems. 6th September, 1955. (784517.)

27122. Marconi Instruments, Ltd.—Screening can arrangements for thermionic valves. 16th June, 1955. (784327.)

27385. Igranic Electric Co., Ltd.—Control systems for circuits including electromagnets. 22nd September, 1954. (784403.)

29210. Lacy, R. D.—Hysteresis motors. 8th August, 1955. (784575.)

29929. General Electric Co., Ltd., and Edwards, E. F.—Electric discharge operated switches. 18th October, 1955. (784406.)

30070. General Electric Co., Ltd.—Automatic telephone systems. 19th October, 1955. (784522.)

31986. South Wales Switchgear, Ltd.—Electrical coil windings. 14th October, 1955. (784411.)

35835. General Electric Co., Ltd.—Photo-electric machine guards. 9th December, 1955. (784328.)

1955

1557. Standard Telephones & Cables, Ltd.—Electronic arrangement for ciphering and deciphering teleprinter signals. 18th January, 1955. (784530.)

1895. Philips Electrical Industries, Ltd.—Method and apparatus for gas shielded electric arc welding. 21st January, 1955. (784233.)

2076. Emmerson, J. W.—Electric soldering tools. 12th January, 1956. (Cognate application 9297, 30th March, 1955.) (784234.)

4958. General Electric Co.—Colour television apparatus. 18th February, 1955. (784534.)

8070. Simplex Electric Co., Ltd.—Mounting arrangements for switches or other controllers in electric cooking stoves. 19th March, 1956. (784427.)

8173. British Thermostat Co., Ltd.—Electrical heating elements. 12th March, 1956. (784428.)

9425. Philips Electrical Industries, Ltd.—Methods of manufacturing semi-conductive bodies. 31st March, 1955. (784431.)

10316. General Electric Co.—Gas turbine jet units. 7th April, 1955. (784341.)

11603. Siemens & Halske Akt.-Ges.—Loading arrangements for electrical systems comprising side circuits and phantom circuits. 21st April, 1955. (784249.)

12153. Western Electric Co., Inc.—Magnetic switching circuits. 27th April, 1955. (784541.)

13957. Siemens-Schuckertwerke Akt.-Ges.—Mercury arc rectifiers. 13th May, 1955. (784440.)

14106. Metropolitan-Vickers Electrical Co., Ltd.—Dynamo-electric machines. 5th April, 1956. (784441.)

15977. Brentford Electric, Ltd.—Refrigerating apparatus. 19th April, 1956. (784592.)

16053. Vereinigte Aluminium-Werke Akt.-Ges.—Current conducting device for electrolysis furnaces. 3rd June, 1955. (784593.)

18191. Plessey Co., Ltd.—Obtaining a low frequency alternating current from a direct current supply. 25th June, 1956. (784444.)

18199. Philips Electrical Industries, Ltd.—Dials. 23rd June, 1955. (784547.)

18424. Automatic Telephone & Electric Co., Ltd.—Dial switches for use in telephone or like switching systems. 24th May, 1956. (784351.)

22141. Compagnie pour la Fabrication des Compteurs et Matériel d'Usines à Gaz.—Electrical apparatus. 2nd August, 1955. (784356.)

24601. Robertshaw-Fulton Controls Co.—Thermostatic electric control device. 26th August, 1955. (784456.)

24881. Accumulatoren-Fabrik Akt.-Ges.—Manufacture of negative electrodes for alkaline accumulators. 21st August, 1953. (Divided out of 780481.) (Addition to 751725.) (784598.)

26269. Allmanna Svenska Elektriska Aktiebolaget.—Electric furnaces for the production of silicon and other materials having similar conditions of reaction. 14th September, 1955. (784363.)

26463. Bendix Aviation Corporation.—Magnetic amplifier demodulator. 15th September, 1955. (784266.)

26484. Allis-Chalmers Manufacturing Co.—Automatic electric circuit-breakers. 15th September, 1955. (784556.)

26693. Compagnie Générale de Télégraphie sans Fil.—Ultra short wave directional couplers. 19th September, 1955. (784364.)

28553. Foxboro Co.—Rotary magnetic multiple electric switch. 6th October, 1955. (784559.)

29154. Proctor Electric Co.—Electric toaster heating unit. 13th October, 1955. (784600.)

29754. Telefonaktiebolaget L. M. Ericsson.—Apparatus for comparing the current/voltage characteristics of two non-linear resistances. 18th October, 1955. (784367.)

29844. Horne, R. F. (Toch, S. J.).—Relay devices for electricity supply systems. 19th October, 1955. (784467.)

32243. Radio Corporation of America.—Noise cancelling circuits. 10th November, 1955. (784468.)

32285. Standard Telephones & Cables, Ltd.—Wide band radio frequency transformer. 11th November, 1955. (784372.)

33424. Calor-Emag Elektrizitäts Akt.-Ges.—Fluid-blast electric switches. 22nd November, 1955. (784373.)

34166. Philips Electrical Industries, Ltd.—Ionisation chambers for radiation measurements. 29th November, 1955. (784471.)

37112. Wilcolator Co. — Thermally operated overload circuit-breakers. 28th December, 1955. (784567.)

37175. General Mills, Inc.—Assembly machine for circuit components. 28th December, 1955. (784276.)

1956

2457. Standard Telephones & Cables, Ltd.—Electric pulse generators and frequency dividers employing semi-conductors. 25th January, 1956. (Addition to 726496.) (784379.)

2644. Pertrix-Union Ges.—Galvanic batteries. 26th January, 1956. (784380.)

6607. Standard Telefon Og Kabelfabrik Aktieselskap.—Electronic apparatus for producing cipher key tape for printing telegraphy. 2nd March, 1956. (784384.)

7648. Hazeltine Corporation.—Colour television image-reproducing apparatus of the image-protection type. 12th March, 1956. (784570.)

11131. Electrolux Corporation.—Vacuum cleaners. 12th April, 1956. (784606.)

13956. Young, S. G.—Electrical socket outlets having movable spring-urged shutter members. 15th January, 1954. (Divided out of 784498.) (784499.)

TRADE MARKS

APPLICATIONS have been made for the registration of the following trade marks. Objections may be entered up to 11th October:—

GENPAK. No. 766,567. Class 7. Units comprising electric generators powered by diesel engines.—Davey Paxman & Co., Ltd., Standard Iron Works, Colchester.

TRAVELUX. No. 765,060. Class 8. Electric shaving instruments.—Tellux, Ltd., 146, New Cavendish Street, London, W.1.

DUMONT (design). No. B745,608. Class 9. Television receivers and television transmitters, cathode ray tubes, electronic instruments and parts.—Allen B. Dumont Laboratories, Inc., Clifton, N.J., U.S.A. Address for service, c/o Frank B. Dehn & Co., Kingsway House, 103, Kingsway, London, W.C.2.

FULLWOOD. No. 749,294. Class 9. Electrical apparatus for charging cattle fencing and the like, and parts and fittings.—R. J. Fullwood & Bland, Ltd., 25-35, Bevenden Street, London, N.1.

FOUR SQUARE (design). No. 761,002. Class 9. Domestic electric appliances, electric vacuum cleaning apparatus and parts.—W. A. McLellan, Ltd., 13, Charterhouse Street, London, E.C.1.

TETCOL (design). No. 763,108. Class 9. Scientific instruments, scientific glassware and electronic apparatus and instruments.—Electrical Thermometer Co., Ltd., 1, Stroud Green Road, Finsbury Park, London, N.4.

KOERZIT. No. 763,995. Class 9. Electrical apparatus and instruments incorporating magnets, and magnets and parts.—Fried. Krupp in Essen, Germany. Address for service, c/o Brewer & Son, 5 to 9, Quality Court, Chancery Lane, London, W.C.2.

C-OMATIC. No. 764,761. Class 9. Electric welding apparatus.—A. G. Smith Corporation, Milwaukee, Wisconsin, U.S.A. Address for service, c/o Stevens, Langner, Parry & Rollinson, 5 to 9, Quality Court, Chancery Lane, London, W.C.2.

PAGEMASTER. No. 764,546. Class 9. Electrical instruments and apparatus, and parts.—General Dynamics Corporation, New York, U.S.A. Address for service, c/o Stevens, Langner, Parry & Rollinson, 5 to 9, Quality Court, Chancery Lane, London, W.C.2.

CSF (design). No. B734,358. Class 17. Insulating material and insulators, all made of ceramics.—Compagnie Générale de Télégraphie sans Fil, Paris, France. Address for service, c/o Haseltine, Lake & Co., 28, Southampton Buildings, Chancery Lane, London, W.C.2.

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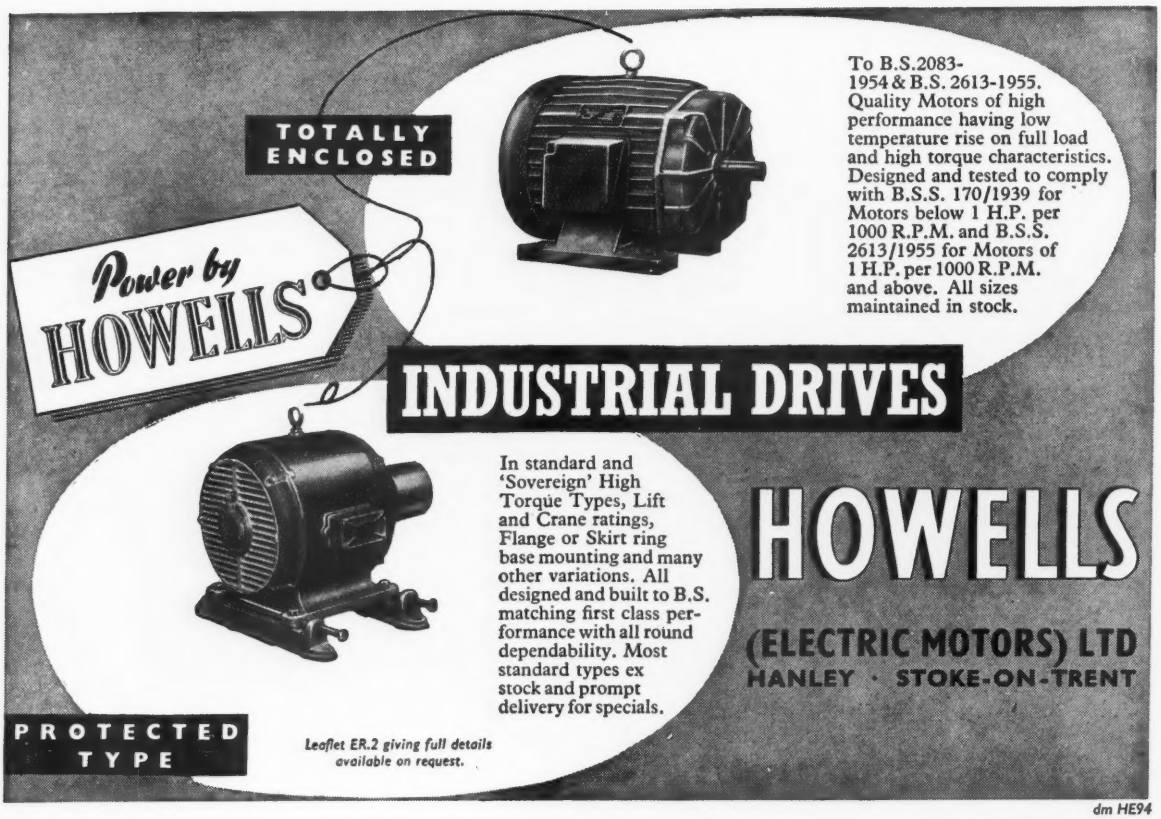
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NEXT WEEK'S EVENTS

Organisers of electrical functions are advised to make use of the "Electrical Review" clearing house, Room 221, Dorset House, Stamford Street, London, S.E.1, to ascertain that proposed dates for their functions do not clash with others already arranged.

Monday, 7th October

BIRMINGHAM.—Grand Hotel, 6 p.m. I.E.E., South Midland Centre. Annual general meeting and Chairman's address, by L. L. Tolley, followed at 7.30 p.m. by a Conversazione.

ILFORD.—Angel Hotel, 8 p.m. A.S.E.E., North East London Branch. "Push Button Housekeeping," by Mrs. M. E. Pickford.

LEEDS.—Great Northern Hotel, 7.30 p.m. A.S.E.E., Leeds Branch. "Radiations for Diagnostic and Therapeutic Purposes," by A. E. Holland.

LIVERPOOL.—At the Royal Institute, Colquitt Street, 6.30 p.m. I.E.E., Mersey and North Wales Centre. Chairman's address, "Development of Electrical Services in a Soap and Chemical Factory," by T. Makin.

LONDON.—Caxton Hall, S.W.1, 7 p.m. E.P.E.A. London Technical Group. "Supervisory Remote Control as Applied to Distribution Networks," by L. J. Day.

NEWCASTLE-UPON-TYNE. — Ministry of Labour and National Service, 93a, Grey Street, 6.30 p.m. Institution of Works Managers, Tyne-Wear Branch. "Industrial Engineering," by C. Fitton.

NORWICH.—Assembly House, 7.30 p.m. I.E.E., East Anglian Sub-Centre. Chairman's address, "Education for Engineers," by G. E. Middleton.

SHEFFIELD.—Royal Victoria Station Hotel, 7.30 p.m. A.S.E.E., Sheffield Branch. "Automatic Heating Controls," by G. C. Fox.

Tuesday, 8th October

BELFAST.—Queen's University, 6.30 p.m. I.E.E., Northern Ireland Centre. Chairman's address, "Brief Review of the Progress of the Electricity Board for Northern Ireland," by C. M. Stoupe.

CAMBRIDGE. — Cambridgeshire Technical College, 6.30 p.m. I.E.E., Cambridge Radio and Telecommunication Group. Chairman's address, by N. C. Rolfe.

LONDON.—Savoy Place, W.C.2, 5.30 p.m. I.E.E., Measurement and Control Section. Chairman's address, "Meters and Meter Engineers," by H. S. Petch.

At the Royal Institution, Albemarle Street, W.1, 6 p.m. Illuminating Engineering Society. Presidential address, "Designing for Harmony," by E. B. Sawyer.

Connaught Rooms, W.C.2, 12.30 for 1 p.m. Electrical Industries Club. Luncheon. Guest speaker, Sir Hugh Beaver.

LOUGHBOROUGH. — Loughborough College, 6 p.m. I.E.E., East Midland Centre. Chairman's address, by J. D. Pierce, and annual general meeting.

MANCHESTER. — Engineers' Club, Albert Square, 6.15 p.m. I.E.E., North Western Utilisation Group. "Electrical Floor Warming," by J. W. Moule and W. M. Stevenson.

Engineers' Club, Albert Square, 7.15 p.m. Incorporated Plant Engineers, Manchester Branch. "Chain Grate Stokers," by C. H. G. Hayward.

PORTSMOUTH.—Wiltshire Lamb Hotel, 7.30 p.m. A.S.E.E., Portsmouth and District Branch. "Safety in Electrical Installations," by S. J. Emerson.

YORK.—Royal Station Hotel, 7.30 p.m. A.S.E.E., York Branch. "Switchgear and Motor Control Gear," by J. F. Cummings.

Wednesday, 9th October

BIRMINGHAM.—James Watt Memorial Institute, 6.30 p.m. I.E.E., South Midland Graduate and Student Section. Chairman's address, by M. J. L. Willison.

Birmingham Exchange and Engineering Centre, Stephenson Place, 7.30 p.m. A.S.E.E., Birmingham Branch. "Plastics in the Electrical Industry," by S. F. Sandford and W. E. Downing.

HALIFAX.—Crown Hotel, Horton Street, 7.45 p.m. A.S.E.E., Halifax Branch. "Some Aspects of Street Lighting," by J. H. Mollan.

LEEDS.—Combustion Engineering Association, Northern Region. Visit to Skelton Grange generating station.

LONDON.—Savoy Place, W.C.2, 6.30 p.m. I.E.E., London Graduate and Student Section. Chairman's address, by F. L. Fielding.

Caxton Hall, Caxton Street, S.W.1, 6 p.m. Institution of Engineers-in-Charge. Annual general meeting.

MANCHESTER. — Engineers' Club, Albert Square, 6.45 p.m. I.E.E., North Western Radio and Telecommunication Group. Chairman's address, by K. J. Butler.

NEWCASTLE-UPON-TYNE. — Neville Hall, Westgate Road, 6 p.m. British Institution of Radio Engineers, North Eastern Section. "High Fidelity Loud Speakers," by R. A. Bull.

OXFORD.—Southern Electricity Board, 37, George Street, 7 p.m. I.E.E. district meeting. "Visit of Electrical Delegation to Russia," by D. P. Sayers.

PRESTON.—North Western Electricity Board Demonstration Theatre, 19, Friargate, 7.15 p.m. I.E.E., North Lancashire Sub-Centre. Chairman's address, by H. G. Cope.

RUGBY.—Rugby College of Technology and Arts, 6.30 p.m. I.E.E., Rugby Sub-Centre. Chairman's address, by W. J. Carfras.

WOLVERHAMPTON. — Wolverhampton and Staffordshire Technical College, Wulfruna Street, 7.15 p.m. British Institution of Radio Engineers, West Midlands Section. "Transistors—Circuits and Applications," by M. D. Cooper.

Wednesday, 9th October, to Friday, 11th October

LONDON.—Royal Horticultural Society's New Hall, S.W.1. Engineering Industries Association London Regional Display.

Thursday, 10th October

CHELMSFORD. — Crompton's Social Hall, 7.30 p.m. Chelmsford Engineering Society. Presidential address, by G. J. Corson.

GLASGOW.—Scottish Building Centre, 425-427, Sauchiehall Street, 7.15 p.m. Incorporated Plant Engineers, Glasgow Branch. "The Measurement and Prevention of Smoke from Industrial Boilers," by T. F. Hurley.

HULL.—Yorkshire Electricity Board, Ferensway, 6.30 p.m. I.E.E., North Midland Centre. "A New Meter for the kVA Demand Charge," by P. Baxter.

LONDON.—Savoy Place, W.C.2, 5.30 p.m. I.E.E., Utilisation Section. Chairman's address, "Joints and Hinges," by J. Vaughan Harries.

NEWCASTLE-UPON-TYNE.—Roadway House, Oxford Street, 7 p.m. Incorporated Plant Engineers, North East Branch. "The Manufacture of Tubes," by H. B. Elliot.

NOTTINGHAM.—East Midlands Electricity Board, Smithy Row, 6 p.m. I.E.S., Nottingham Centre. Chairman's induction and visit of the president.

SWANSEA.—South Wales Electricity Board, The Kingsway, 6 p.m. I.E.E., West Wales (Swansea) Sub-Centre. Chairman's address, by I. G. Evans.

WIMBLEDON. — Prince of Wales Hotel, 8.30 p.m. A.S.E.E., South West London Branch. Debate on "Wiring Systems."

Friday, 11th October

LONDON.—Caxton Hall, Westminster, 6.30 p.m. E.P.E.A., Southern Meter Engineers' Group. "Progress in Protection," by M. Kaufmann.

STOKE.—Grand Hotel, Hanley, 7.30 p.m. A.S.E.E., Stoke and Crewe Branch. "Earth Leakage Protection of Domestic and Similar Installations," by J. A. Robbins.

Street Lighting Notes

Boldon (Co. Durham) U.D.C. is to carry out electric street lighting schemes costing about £13,000. It is proposed to borrow £7,800 to carry out part of the work, and other schemes to cost over £5,200 will be financed from the general rate fund.

Middlesbrough Town Council has been authorised by the Ministry of Transport to proceed with a street lighting improvement scheme for Ormesby Road, but the Ministry has withheld approval of similar plans for Acklam Road.

Newcastle-on-Tyne City Council is being recommended to speed up its plan for converting street lighting from gas to electricity, so that the whole of the work is completed in five years, instead of eight years, as originally intended. The scheme began two years ago, when it was planned to convert 1,000 lamps yearly. The work has progressed quicker than expected and it is suggested that the rate of conversion should be increased to 1,600 a year. The Watch Committee has asked the Council for a supplementary estimate of £60,000 to cover the increased work proposed to be carried out in the third year of the programme. When the scheme is completed, there will be a saving of £11,000 annually on maintenance costs, compared with gas lighting.

The estimated cost of providing new street lighting along the Coast Road from Tynewydd Road, Russell Road and Wellington Road to the Foryd bridge, **Rhyl,** is £7,150. The Council is to ask for sanction to borrow the money to carry out the work.

Richmond (Surrey) Highways Committee is holding a special meeting on 30th October to hear complaints by residents against the conversion of lighting in the borough's side roads from gas to electricity. During a well-organised campaign the residents have protested that concrete posts are out of place in certain streets which have either historic or æsthetic associations, and that in some small roads the new lighting is unnecessarily powerful. In particular, concern is felt about the effect of new lights on such parts of the town as the riverside, Richmond Green and Kew Green, and the area round Richmond parish church.

Wood Green Borough Council has deferred consideration of a scheme for converting the whole of the gas street lighting in the borough to sodium discharge lighting and has asked the borough engineer to submit proposals for roads which should be given priority. The cost of complete conversion is estimated at £60,000.

Lighting Course

The Lighting Service Bureau informs us that the move to new premises has been postponed and that the autumn lighting course will again be held in the lecture theatre at 2, Savoy Hill, London, W.C.2. The lectures will be held on consecutive Wednesday evenings, commencing on 30th October, and each lecture will be repeated on the following evening. Applications for tickets should be made to the Bureau at 2, Savoy Hill.

CONTRACT INFORMATION

Accepted Tenders and Prospective Electrical Work

CONTRACTS OPEN

Where "Contracts Open" are advertised in our "Official Notices" section the date of the issue is given in parentheses

Australia.—Victorian Railways, Melbourne. 16th October. A.c. circuit-breakers and reactors. (E.S.B. 23280/57. Ten/28251.)*

Electricity Commission of New South Wales, Sydney. 4th November. Miniature type control boards and associated interposing current transformers. (E.S.B. 22876/57. Ten/28155.)*

Burma.—Electricity Supply Board, Rangoon. 15th November. Instruments for locating faults in transmission and distribution lines. (E.S.B. 23472/57. Ten/28273.)* 22958/57. Ten/2818.)* 2nd December. H.v. shunt capacitors. (E.S.B. 23399/57. Ten/28272.)*

India.—Madras State Electricity Board. 30th October. H.v. insulators. (E.S.B. 22958/57. Ten/28178.)* 2nd December. H.v. shunt capacitors. (E.S.B. 23399/57. Ten/28272.)*

Railway Stores, Railway Board, New Delhi. 23rd November. Diesel hydraulic shunting locomotive and PIS and ZE type boilers. 14th December. Electric locomotives and diesel engine driven d.c. train generating set. (E.S.B. 30199/57. Ten/28111.)*

Damodar Valley Corporation, Calcutta. 15th November. Metalclad indoor switchgear. (E.S.B. 23526/57. Ten/28283.)*

Bombay State Electricity Board, Nagpur. 19th November. Coal handling plant for Khaperkheda power station. (E.S.B. 23199/57. Ten/28247.)*

Largs.—Corporation. Firms wishing to tender for trunk road lighting should apply by 9th October. (See this issue.)

Leicester.—Education Committee. 15th October. Electrical installation at the new Alderman Newton Girls' Grammar School. J. H. Lloyd Owen, city architect, 10, Loseby Lane.

Malta. — Maltese Government. 2nd December. Sewage pumping plant. (See this issue.)

New Zealand. — State Hydro-Electric Department, Wellington. 26th November. Transmission line towers. 4th February. Four 10,000 kVA transformer units. 11th February. Eight 6,667 kVA transformer units. (E.S.B. 2337-3/57. Ten/28262-64.)*

Invercargill. 7th November. 11 kV ring main and tee-off switch units. (E.S.B. 23228/57. Ten/28269.)*

Omagh.—Tyrone County Education Committee. 21st October. Electrical installation in new primary school. W. & M. Given, consulting engineers, 1, Waterside, Coleraine.

Ormskirk.—U.D.C. 21st October. Street lighting equipment. (See this issue.)

Pakistan.—Posts and Telegraphs, Karachi. Cadmium copper wire. (E.S.B. 23484/57. Ten/28250.)* 20th November. Carrier cable system. (E.S.B. 23082/57. Ten/28250.)*

Rhodesia and Nyasaland.—Federal Tender Board, Causeway. 10th October. Underground cable and joint boxes for Bulawayo Airport. (E.S.B. 23165/57. Ten/28241.)* Armoured cable. (E.S.B. 23166/57. Ten/28223.)*

City of Bulawayo. 16th October. Transformer cooling water flow indicators. 6th November. 11 kV isolating switches, eighteen 100 kVA and twelve 200 kVA transformers. (E.S.B. 23297-9/57. Ten/28258-60.)*

* Specifications may be inspected at the Export Services Branch, Board of Trade, Lacon House, Theobald's Road, London, W.C.1 (Chancery 4411; extension 769).

Saltburn and Marske (Yorks).—U.D.C. Electrical installations in 110 houses. Surveyor, Council Offices, Marske.

Scunthorpe.—Corporation. 22nd October. Trunk road lighting equipment. (See this issue.)

South Africa.—Union Tender and Supplies Board, Pretoria. 10th October. Flameproof fluorescent equipment. (E.S.B. 23364/57. Ten/28245.)* 17th October. Fault locating bridges and portable spot galvanometer. (E.S.B. 23518/57. Ten/28266.)*

Stores Department, South African Railways. 16th October. 60 W and 100 W flameproof fittings. (E.S.B. 22778/57. Ten/28192.)*

South West Africa.—Tender Board, Windhoek. 11th October. Screwed steel electric conduit. (E.S.B. 22829/57. Ten/28254.)*

Thailand. — Telephone Organisation, Bangkok. 11th October. Underground and overhead cables. (E.S.B. 23052/57. Ten/28224.)*

United States.—Bureau of Reclamation, Denver. 15th October. Power circuit-breaker. (E.S.B. 22911/57. Ten/28183.)*

Uruguay.—Administracion Nacional de Combustibles Alcohol y Portland, Montevideo. 31st October. Centrifugal pumps, motors and accessories. (E.S.B. 23146/57. Ten/28212.)*

Administracion General de las Usinas Electricas y los Telefonos del Estado. 5th November. Time switches, switches and relay control equipment. (E.S.B. 22539/57. Ten/28243.)*

WORK IN PROSPECT

Particulars of new works and building schemes for the use of electrical installation contractors and traders. Publication in this section is no guarantee that electrical work is definitely included. Alleged inaccuracies should be reported to the Editors

Aberdare.—Houses (94), Moriah Place, Llwydcoed; U.D.C. surveyor, Vestry Hall.

Barnes.—Flats (32), Kew Nursery site; W. R. Shepherd, borough engineer, Municipal Offices, Sheen Lane, S.W.14.

Barnsley.—Fire service headquarters comprising three-storey block with appliance room wing; A. E. Gilfillan, town clerk, Town Hall.

Billingham-on-Tees.—Multi-storey offices for Imperial Chemical Industries, Ltd.; John Laing & Sons, contractors, Dalston Road, Carlisle.

Burnley.—Grammar school for boys; borough engineer.

Cambridge.—R.C. church, Milton Road; Wearing & Hastings, architects, 3, Redwell Street, Norwich.

Cannock.—Houses (144), Johns Lane site, Great Wyrley; J. P. Roberts, clerk to R.D.C., Council Offices, Penkridge, Stafford.

Carlisle.—Works, Durranhill estate; British Oxygen Gases, Ltd., Spencer House, St. James's Place, London, S.W.1.

Chesterfield.—School for educationally sub-normal children on Westholme site, Ashgate; borough architect.

Cirencester.—Occupation centre and clinic (£24,000); county architect, Shire Hall, Gloucester.

Colchester.—Houses (107), Prettygate, Barn Hall, Shrub End, Mill Road, Monkwick, and Berechurch Road; J. S. Orchard, borough engineer, West Stockwell Street.

Croydon.—Rebuilding works; Trojan, Ltd., Trojan Way.

Dalston (Cumberland).—Proposed factory for the Nestlé Co., Hayes, Middlesex; H. J. Harvey, architect, 8, King Street, Hammersmith, London, W.6.

Epping.—Ivy Chimneys County Primary School (£40,000); H. Conolly, Essex county architect, County Hall, Chelmsford.

Fawley.—First stage of chemical plant for Monsanto Chemicals, Ltd.; Sir Robert McAlpine & Sons, Ltd., contractors, 80, Park Lane, London, W.1.

Glasgow.—Development of new housing estate at South Nitshill for over 1,000 houses, 41 flats, shops, schools, old persons' home, etc.; Architects' Department, Municipal Buildings, George Square, Glasgow.

Hurstpierpoint.—Dwellings (36); surveyor, Council Offices, Boltro Road, Haywards Heath.

Huyton.—Houses (111), Morscroft Farm estate; H. K. Pilkington, architect, Grasscroft, Archway Road.

Keighley.—Factory, offices and canteen; Keighley Lifts, Ltd., Vulcan Works, Dalton Lane.

Leyton.—Additions to high school for girls (£19,000); H. Conolly, Essex county architect, County Hall, Chelmsford.

London. — Rebuilding St. Michael's Church, College Hill and College Street; Devereux & Davies, architects, 3, Gower Street, W.C.1.

Luxury hotel, Sloane Street and Cadogan Place; Michael Rosenauer, architect, 13, Old Burlington Street, W.1.

Flats (138), Braithwaite Place, Paddington; borough architect.

Dwellings (84), Alberta Street, Southwark; borough surveyor.

Maidenhead.—Municipal offices; North & Partners, architects, 40, Broadway.

Marlow.—Flats (16), Dean Street redevelopment; Henry Cooper & Sons, quantity surveyors, 64, London Road, Reading.

Nantwich.—Factory, Worleston Road; Wilhall Engineering Co., Ltd., 19/21, Ludford Street, Crewe.

Newcastle-on-Tyne.—Three-storey flats at Silver Lonnen and Silver Hill Drive; E. Jeffcock, Ltd., builders, 107, New Bridge Street, Newcastle.

North Riding.—Proposed Stokesley Grammar and Modern School (2nd stage); Collins, Melvin Ward & Partners, architects, 15, Manchester Square, London, W.1.

Old Fletton (Hunts).—Houses (30), Wright Avenue and Central Avenue; C. W. Shelton, Ltd., Eastgate, Peterborough.

Oundle (Northants).—Houses (46), Rock Road extension site; Council's architect.

Oxford.—Secondary school for girls, Gipsy Lane; city architect.

Portsmouth.—Factory extension for Thomas & Evans, Ltd., Gruneisen Road; Powell & Alport, architects, 88, Cathedral Road, Cardiff.

Ramsgate.—Bungalows (50), West Dumpton Lane; Frank E. Wood, builder, 17, Woodnesborough Road, Sandwich.

Rothwell.—Houses (80), Hazel House Farm site, Methley; R. A. Easdale & Sons, architects to U.D.C., County Chambers, Castleford.

Rugby.—Houses (278), Featherbed Lane estate; borough architect.

Stafford.—Factory extensions in Tixall Road; W. H. Dorman & Co., engineers.

Stevenage.—Works extensions for British Tabulating Machine Co., Ltd.; David Chaston, Ltd., builders, Essex Road, Hoddesdon.

Wigan.—Four-storey blocks of flats and maisonnettes, Folley and Graysons Yard site; borough engineer, Municipal Buildings, Library Street.

Wolverhampton.—Works extensions for Chubb & Sons Lock & Safe Co., Ltd., Wednesfield Road; M. A. Boswell, Ltd., contractors, 124, Compton Road.

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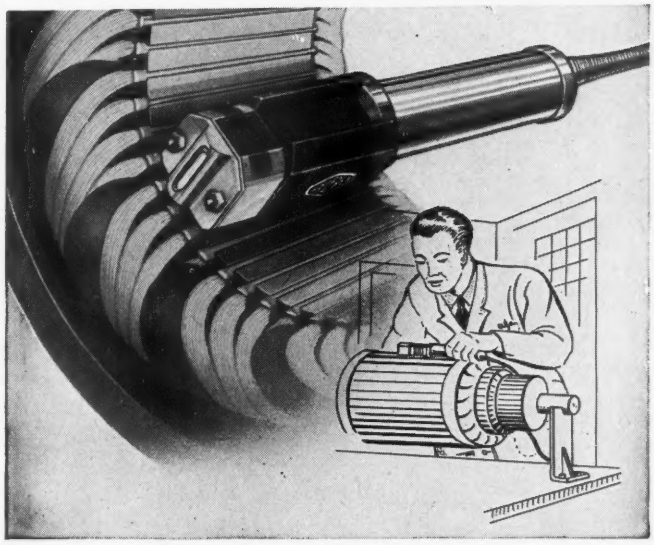

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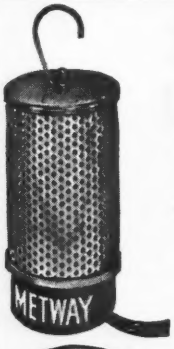

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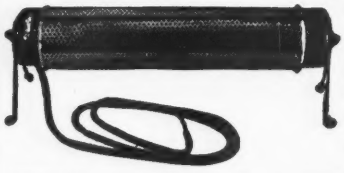

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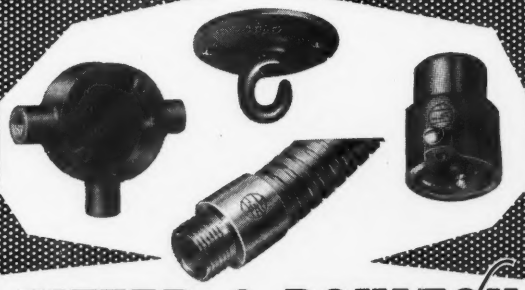

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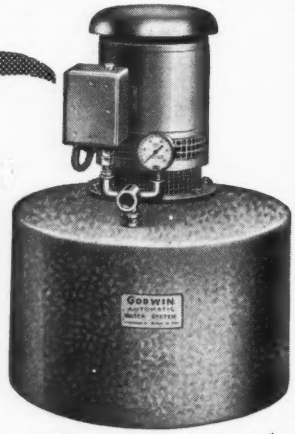

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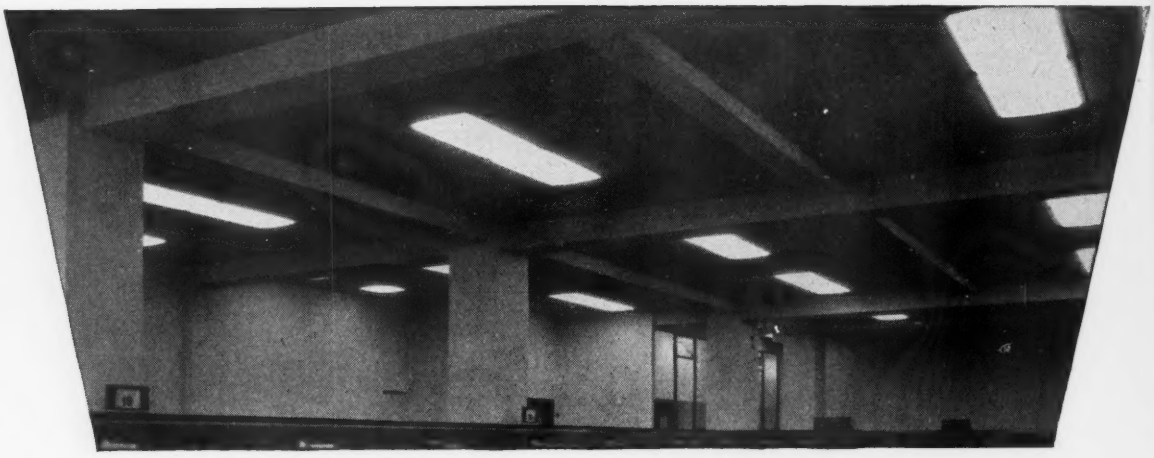

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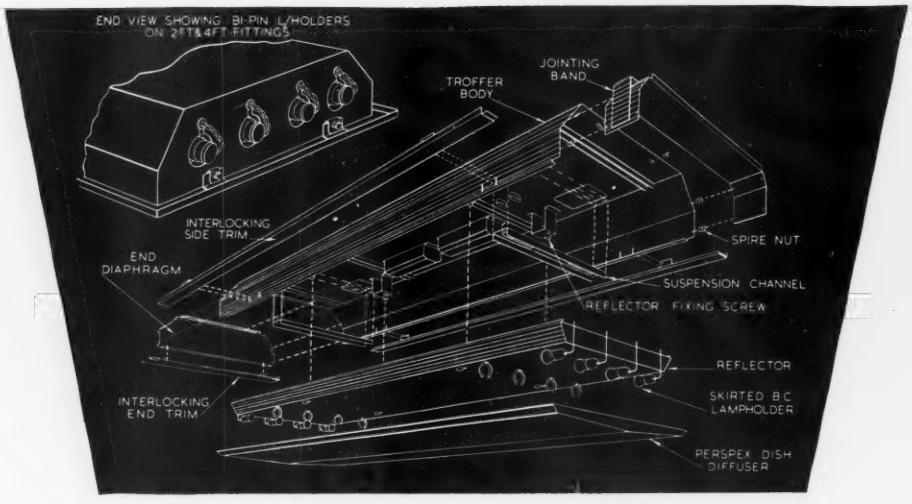

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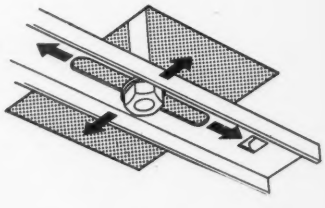

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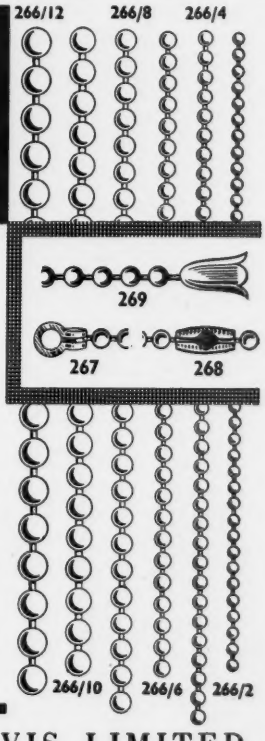

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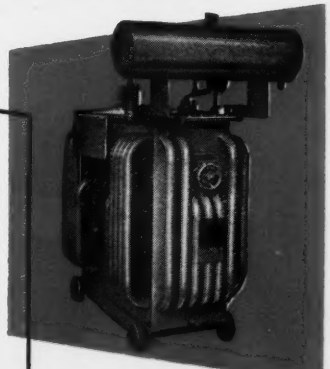

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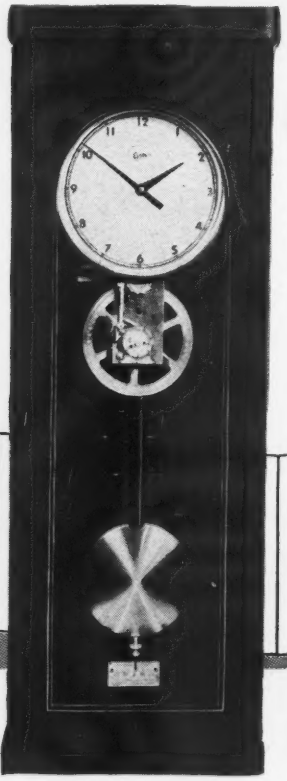

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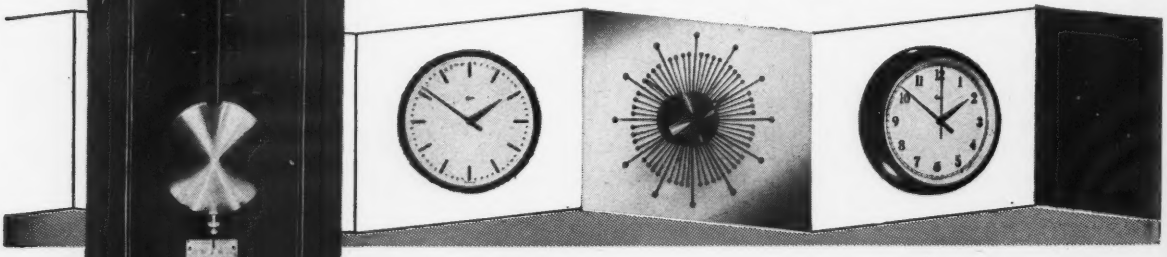

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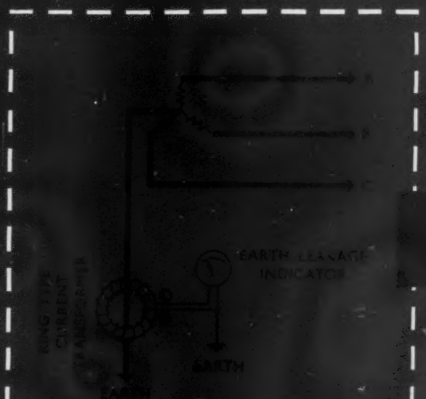

INDICATORS

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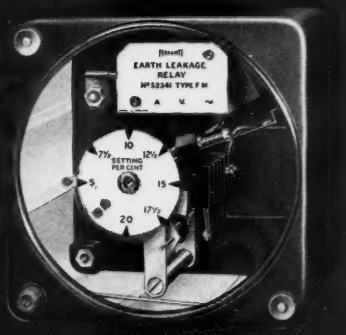

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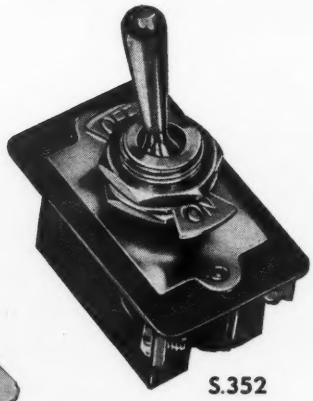

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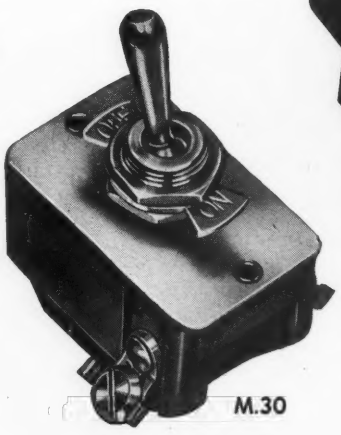

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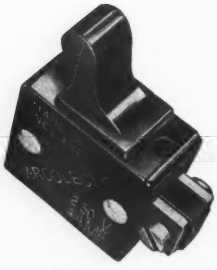

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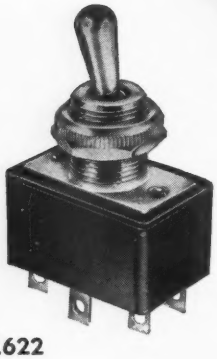

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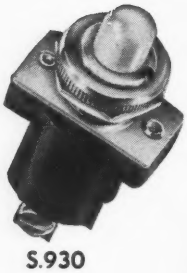
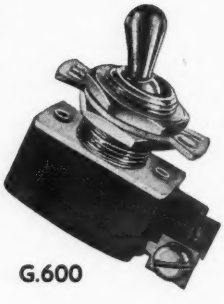
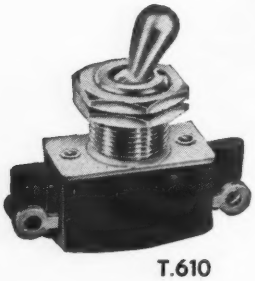


S.930



G.600



T.610

S.352: Toggle Switch, 5-amp., 250v.

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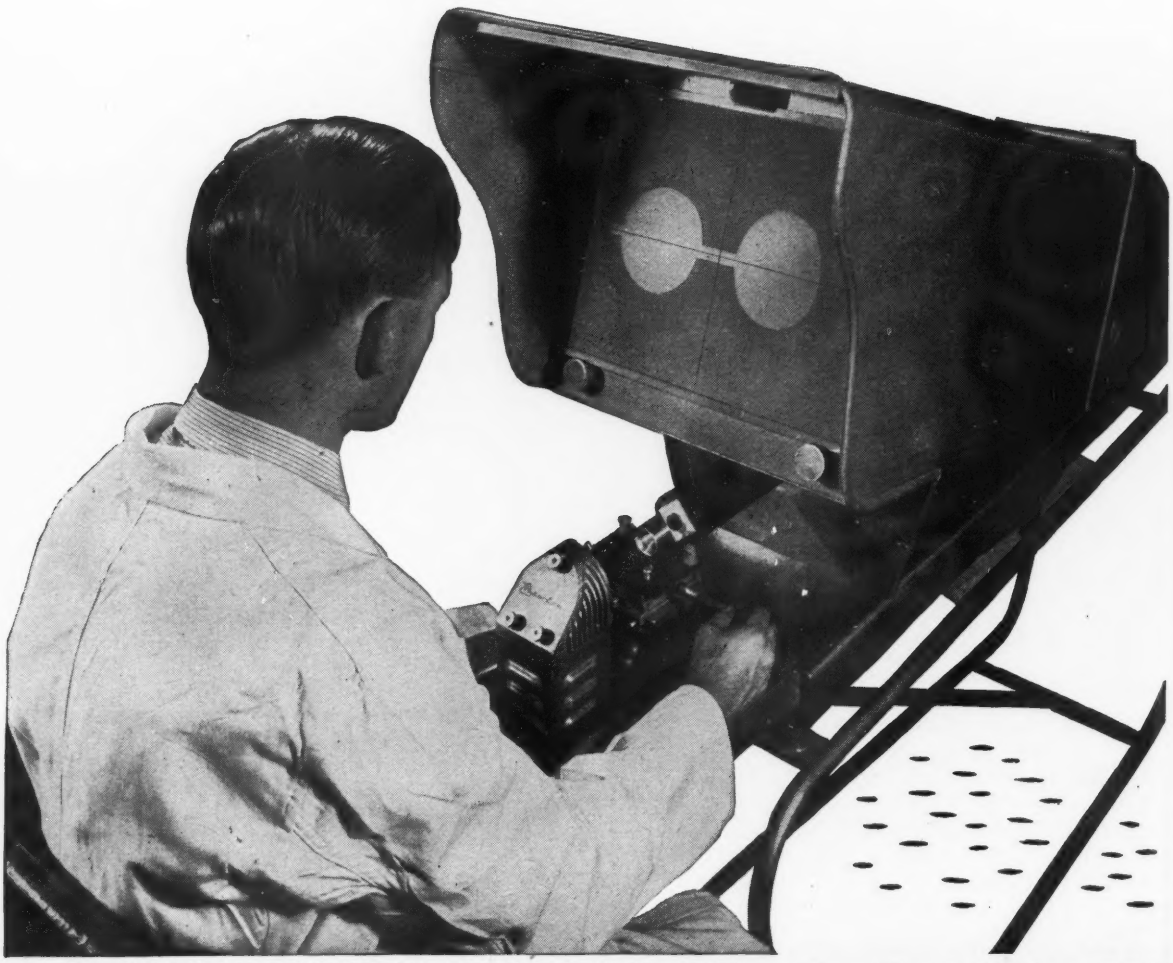

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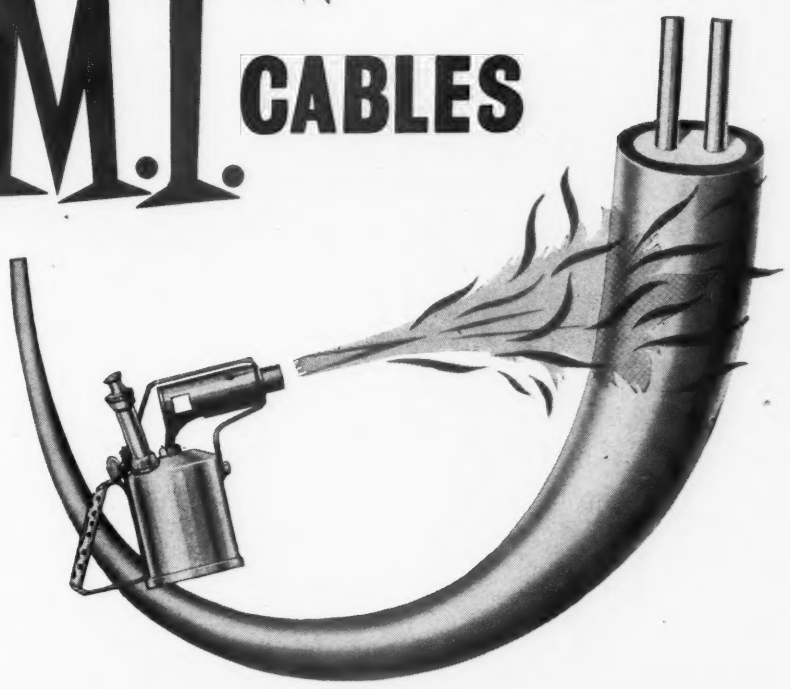

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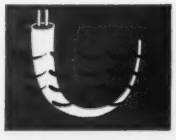

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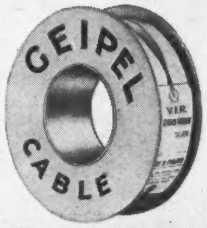

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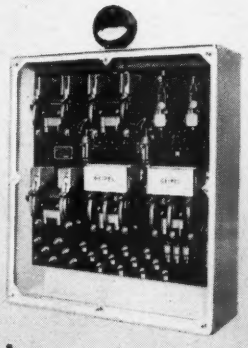

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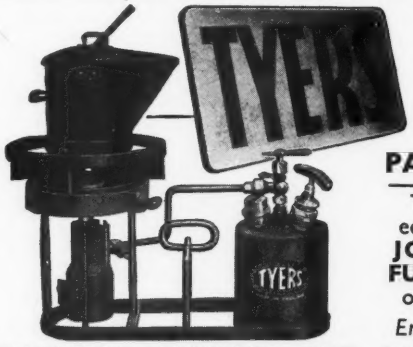

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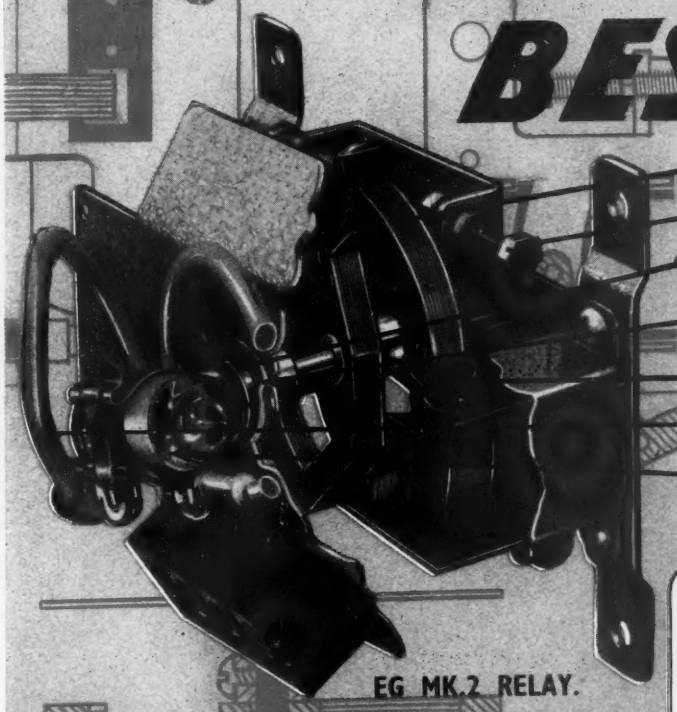

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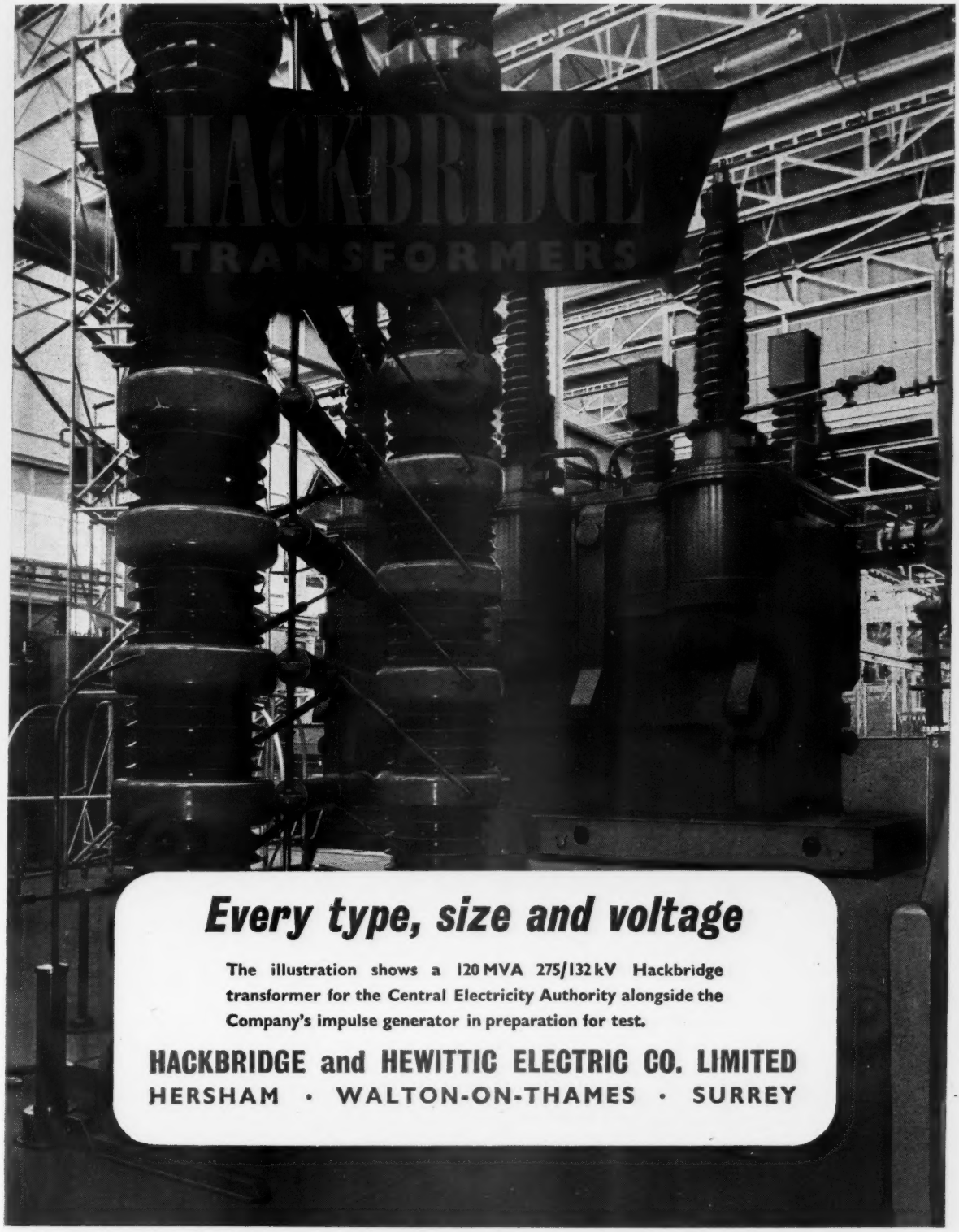

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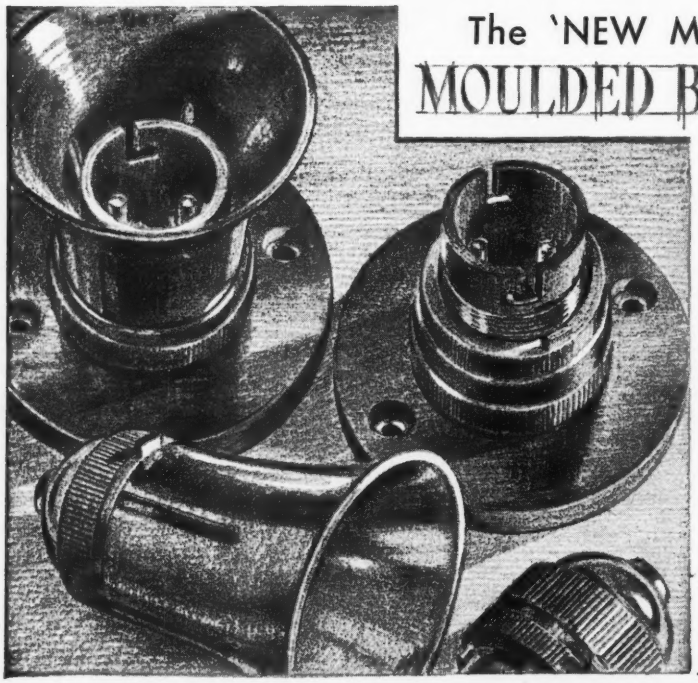

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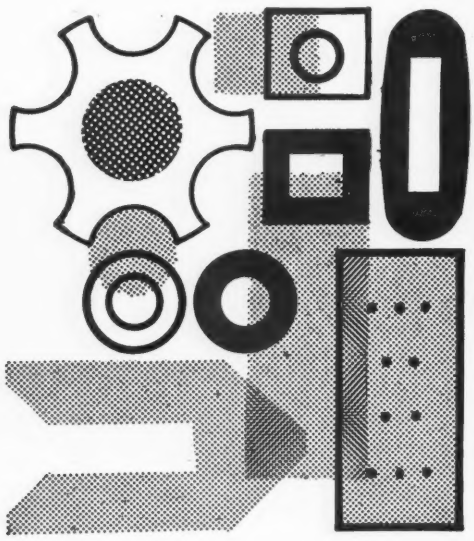

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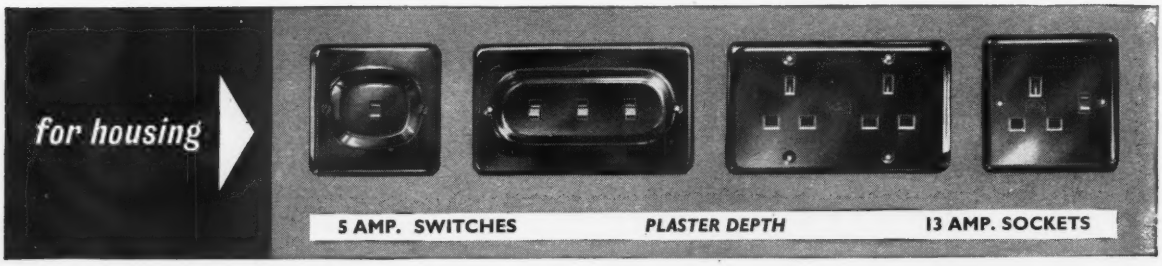

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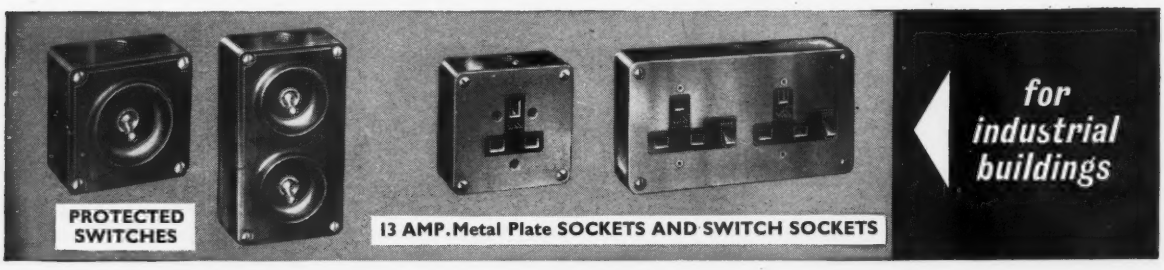

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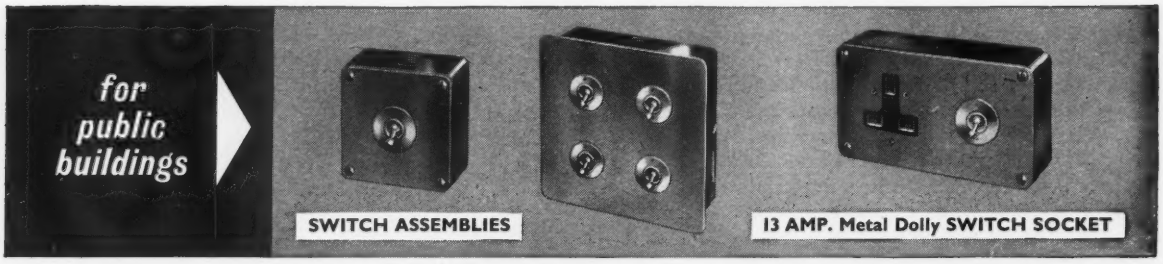

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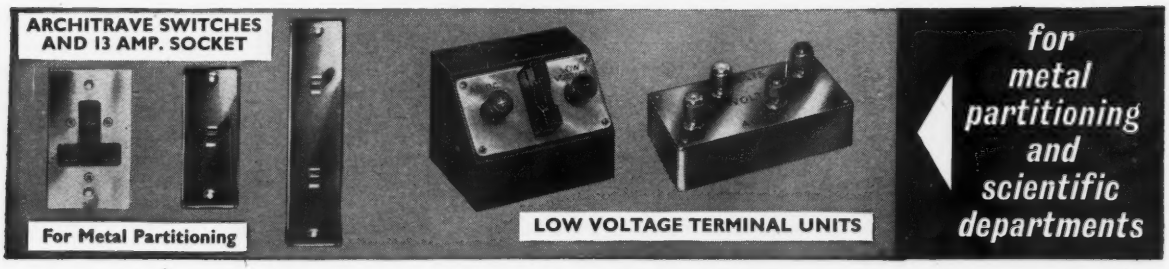
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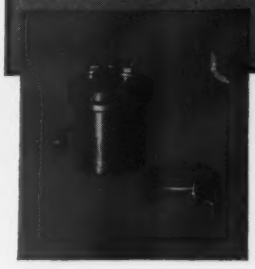

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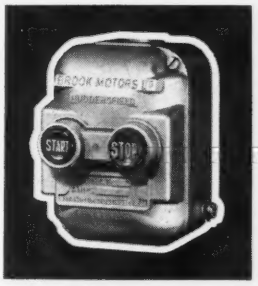

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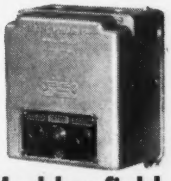

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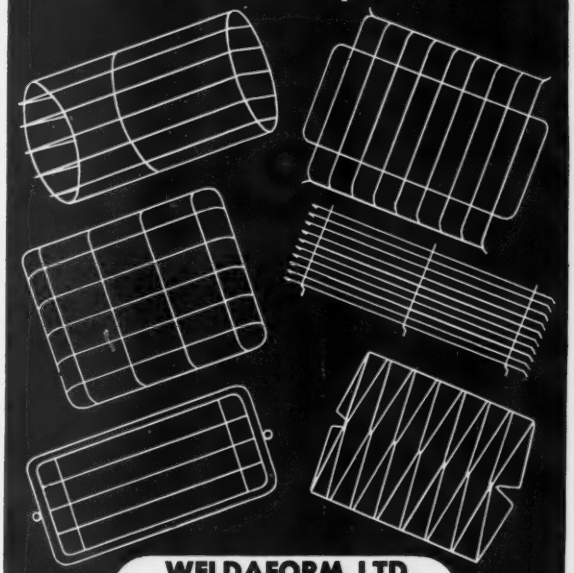

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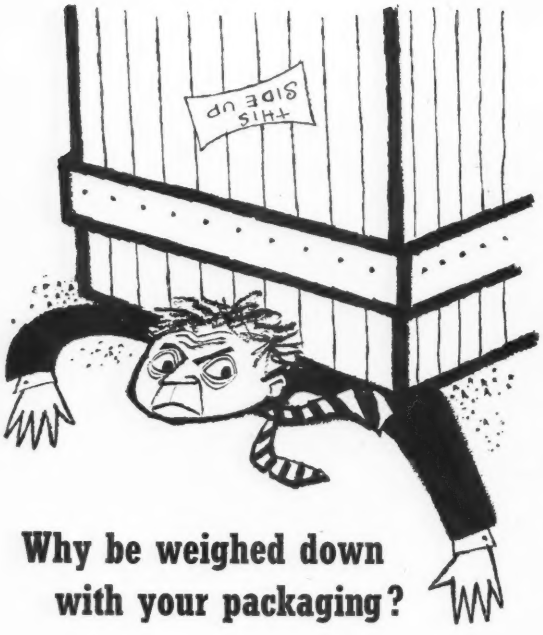

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EDMUNDSONS CONSTRUCTION CO. LTD.
Electrical Engineers and Contractors
24-30 Gillingham Street, S.W.1
Telephone: VICtoria 1713

One of the Largest Electrical Contractors in the Industry
ELECTRICAL INSTALLATIONS LTD.
65 Vincent Square, Westminster, S.W.1
Telephone: VICtoria 2266 (10 lines)

. . . for all electrical installations
F. H. WHEELER & CO. LTD.
39 Victoria Street, S.W.1
Telephone: ABBey 8080 (8 lines)

TROUGHTON & YOUNG LTD.
2 Basil Street, London, S.W.3
Telephone: Kensington 3444
Electrical Engineers and Contractors

BURDETTE & CO. LTD.
150 Clapham Manor Street, S.W.4
Telephone: MACaulay 4555
Industrial Installations. Motor and Generator Repairs. Metallizing Treatments. Complete Electrical Maintenance. Heating and Ventilating.

WILSON ELECTRIC (BATTERSEA) LTD.
122a, Clapham Manor Street, S.W.4
Telephone: MAC 6768 & 3737
Electrical Engineers and Contractors. Motor Rewinds and Repairs. Installations. "Delco" Electric Motors—Approved Stockists and Repairers.

Electrical Engineers and Contractors
J. A. BROWN & PARTNERS LTD.
123 Warwick Road, S.W.5
Telephone: Fremantle 5546

Industrial Installations throughout the Country. Power, Maintenance and Insurance
CITY ELECTRICAL CO.
Emerald Street, W.C.1 *Telephone: HOL. 9722 (6 lines)*
Repairs and Rewinds—Motor Stockists

A. TINDALL & SONS
22 Rosemary Avenue, Enfield
Electrical Engineers and Contractors
Telephone: ENField 6612 (3 lines)

SERVICE ELECTRIC CO. LTD.
Secomak Works, Honeypot Lane, Stanmore, Middx.
Telephone: EDGware 5566-7-8-9
Electrical Installations of every kind. Motor Rewinds. Factory Maintenance

DYNAMO & MOTOR REPAIRS LTD.
North End Road, Wembley Park
Telephone: Wembley 3121
Motor and generator repairs and rewinds. Installations and factory maintenance. Electrical plant stockists

SOUTH EASTERN

GALLIERS
32 St. James's Street, Brighton
Telephone: Brighton 23201-2-3
Farm and Dairy Electrical Equipment

Electrical, Refrigeration and Radio Engineers. Installation Contractors. Lifts. Television
H. BENEY & SONS LTD.
99 South Street, Eastbourne
Telephones 4820/1 (Day and Night)

For first-class A.C. and D.C. Rewinds and Industrial Plant Maintenance
ELECTRICAL POWER REPAIRS (Gillingham) LTD.
Strover Street, Gillingham, Kent
Telephone: Gill. 5200 & 59356 (Day and Night)

BUCHANAN & CURWEN LTD.
Electrical Engineers and Contractors
Fairfield Works, Leatherhead, Surrey
Telephone 3481 (3 lines)
Branches in Dorking and East Horsley

Heavy Engineering and Electrical Contracting
DRAKE & FLETCHER LTD.
Maidstone, Kent
Telephone 2284
Refrigeration. Oil Heating and Drying Installations

F. W. BLANSHARD LTD.
23 Lansdowne Road, Purley, Surrey
Telephone: Uplands 4818, 4819 & 4810
Complete electrical installations. Rewinding and repair of motors and transformers. Manufacturers of control gear for fluorescent.

SOUTHERN

. . . for all electrical installations
F. H. WHEELER & CO. LTD.
32 Brassey Road, Winton, Bournemouth
Telephone: Winton 1609

. . . for all electrical installations
F. H. WHEELER (Southern) LTD.
Clifton Hall, Oakley Road, Shirley, Southampton
Telephone 73867

SOUTH WESTERN

BUCHANAN & CURWEN LTD.
15 Orchard Street, Bristol 1
Telephone 22723
Electrical Engineers and Contractors

. . . for all electrical installations
F. H. WHEELER (Bristol) LTD.
55 Queen Charlotte Street, Bristol 1
Telephone 26907

CLARKE BROS. (Stroud) LTD.
Bath Road, Stroud
Telephone: Stroud 1132/3
Electrical Engineers and Contractors
Rewinds and Repairs. Industrial Installations

EASTERN

Norwich.....Cambridge.....Gt. Yarmouth.....Lowestoft.....Ipswich
EASTERN & HOME COUNTIES ELECTRICAL CONTRACTORS
Specialists in Large Scale Electrical Installation Contracts.
Westwood House, Southtown Road, Gt. Yarmouth
Telephone: Gt. Yarm. 2390

TUCKER BROS. ELECTRICAL ENGINEERS (ESSEX) LTD.
32 Station Lane, Hornchurch, Essex
Telephone: Hornchurch 842
Installation and Maintenance Engineers

V. J. SKERRY (Partners: V. J. & M. W. Skerry)
72 High Street, Huntingdon, Hunts
Telephone: Huntingdon 524
Electrical Engineers and Contractors. (Certificate. Approved Contractors)

(*Continued on page* 102)

(Continued from page 101)

EAST MIDLANDS

Electrical Engineers and Contractors
C. A. J. BILLINGTON LTD.
Cranfield, Bedfordshire
Telephone: Cranfield 293
Industrial Installations throughout the Home Counties

PENNEY & PORTER LIMITED
Riverside Works, Lincoln
Telephone: Lincoln 11337
Industrial & Domestic Electrical Installations. Motor & Generator Repairs & Rewinds. Lift & Plant Maintenance. Neon & Illuminated Signs

MIDLANDS

Electrical Industrial Installations. Power, Heating and Lighting. Factory Maintenance. E.C.A. Electrical Engineers
PARKER, WINDER & ACHURCH LTD.
259 Broad Street, Birmingham 1
Telephone: MIDland 5001

WALKER BROS. (ELECTRICAL ENGINEERS) LTD.
Quality House, Temple Row, Birmingham 2
Telephone: CEN. 7611/5
Electrical Installation Engineers. Industrial Installation Specialists
Established 1895

Electrical Installation Engineers
J. A. BROWN & PARTNERS LTD.
Head Office: 124 Livery Street, Birmingham 3
Telephone: Central 3412
Branches in London and Manchester

HARRIS & SHELDON LTD.
31 Stafford Street, Birmingham 4
Telephone: Central 7101
For all electrical contracting installations, lighting, heating, power, public address, etc.

Electrical and Mechanical Engineers, Factors
THE BIRMINGHAM POWER TRANSMISSIONS LTD.
56-62 Miller Street, Aston, Birmingham 6
Telephone: AST. 2088-9

For Electrical Installations of Quality consult:
HAROLD F. WARD LIMITED
420 Stratford Road, Birmingham 11
Telephone: VIC. 4041 (5 lines)

. . . for all electrical installations
F. H. WHEELER & CO. LTD.
553 Moseley Road, Birmingham 12
Telephone: Calthorpe 2601-2

DYNAMO & MOTOR REPAIRS LTD.
Belgrave Terrace, Soho Road, Birmingham 21
Telephone: Northern 0898
Motor and generator repairs and rewinds. Installations and factory maintenance. Electrical plant stockists

ELECTRICAL INSTALLATIONS LTD.
Faraday Works, Stoney Stanton Road, Coventry
Telephone 2970
Industrial Electrical Work of All Kinds. Over 40 Years' Experience

G. G. WALKER & CO. (Dudley) LTD.
31 Hall Street, Dudley
Telephone 4474/5
Rewinds, Lighting, Power, Electric Furnace, Electronic Installations and Maintenance. Est. 40 years. E.C.A. Members.

THE TRUMAN ELECTRICAL COMPANY
40-42a Upper Bridge Street, Walsall, Staffs
Telephone 2198 (3 lines)
Electrical Installations, Heating and Ventilating

SOUTH WALES

CLARKE BROS. (Stroud) LTD.
Green Park Street, Aberavon
Telephone: Port Talbot 791
Electrical Engineers and Contractors
Rewinds and Repairs. Industrial Installations

. . . for all electrical installations
F. H. WHEELER & CO. LTD.
117 Woodville Road, Cardiff
Telephone 21281-2 *Telegrams: "Whelect"*

CLARKE BROS. (Stroud) LTD.
High Street, Merthyr Tydfil
Telephone: Merthyr Tydfil 377
Electrical Engineers and Contractors
Rewinds and Repairs. Industrial Installations

MERSEYSIDE & N. WALES

TROUGHTON & YOUNG LTD.
46 Rodney Street, Liverpool 1
Telephone: Royal 9231-2
Electrical Engineers and Contractors

H. J. CASH & CO. LTD.
28 Chapel Street, Liverpool 3
Telephone: Central 0452
Electrical Engineers and Contractors

YORKSHIRE

Electrical Engineers and Contractors
SOUTHERN & REDFERN LTD.
Woodhead Road, Bradford 7
Textile Maintenance, Repairs and Rewinds
Telephones: Bradford 23871—Late Phone: Bradford 65837

EDMUNDSONS CONSTRUCTION CO. LTD.
Electrical Engineers and Contractors
2 Hartley Hill, Leeds 2
Telephone: Leeds 33791

. . . for all electrical installations
F. H. WHEELER & CO. LTD.
44 Bank Street, Sheffield 1
Telephone 24015 (3 lines) *Telegrams: "Whelect"*

. . . for all electrical installations
F. H. WHEELER & CO. LTD.
Paver Lane, York
Telephone: York 23172

NORTH WESTERN

STEWART THOMSON & SONS (Liverpool) LTD.
Fort Road, Seaforth, Liverpool 21
Repairs and Rewinds A.C. and D.C. to 3,000 horsepower. Breakdowns, Urgent Repairs, etc. 24-hour service
Telephone: Bootle 2697-8

. . . for all electrical installations
F. H. WHEELER & CO. LTD.
Regal Buildings, Oxford Road, Manchester 1
Telephone: Central 8207-8

Industrial Installations
W. H. SMITH & CO. ELECTRICAL ENGINEERS LTD.
12 York Street, Manchester 2
Telephone: CENtral 2991-6
Works: Praed Road, Trafford Park, Manchester 17

Electrical Engineers and Contractors
J. A. BROWN & PARTNERS LTD.
366 Stretford Road, Manchester 15
Telephone: Moss Side 3157

THE NELSON ENGINEERING CO. LTD.
Telephone: Nelson 1545/6
Electrical and Mechanical Engineers.
Complete Industrial Installations. Rewinds
Netherfield Road, Nelson

H. J. CASH & CO. LTD.
28 Chapel Street, Liverpool 3
Telephone: Central 0452
Electrical Engineers and Contractors

NORTH EASTERN

DALE ELECTRIC (YORKSHIRE) LTD.
Filey, Yorks. Also at Malton and Driffield
Telephone: Filey 2301 (3 lines)
Manufacturers of the DALE diesel and petrol electric generating plants. All types of electrical contracting. Estimates free and without obligation.

. . . for all electrical installations
F. H. WHEELER & CO. LTD.
52 Elswick Road, Newcastle
Telephone: Newcastle 36271

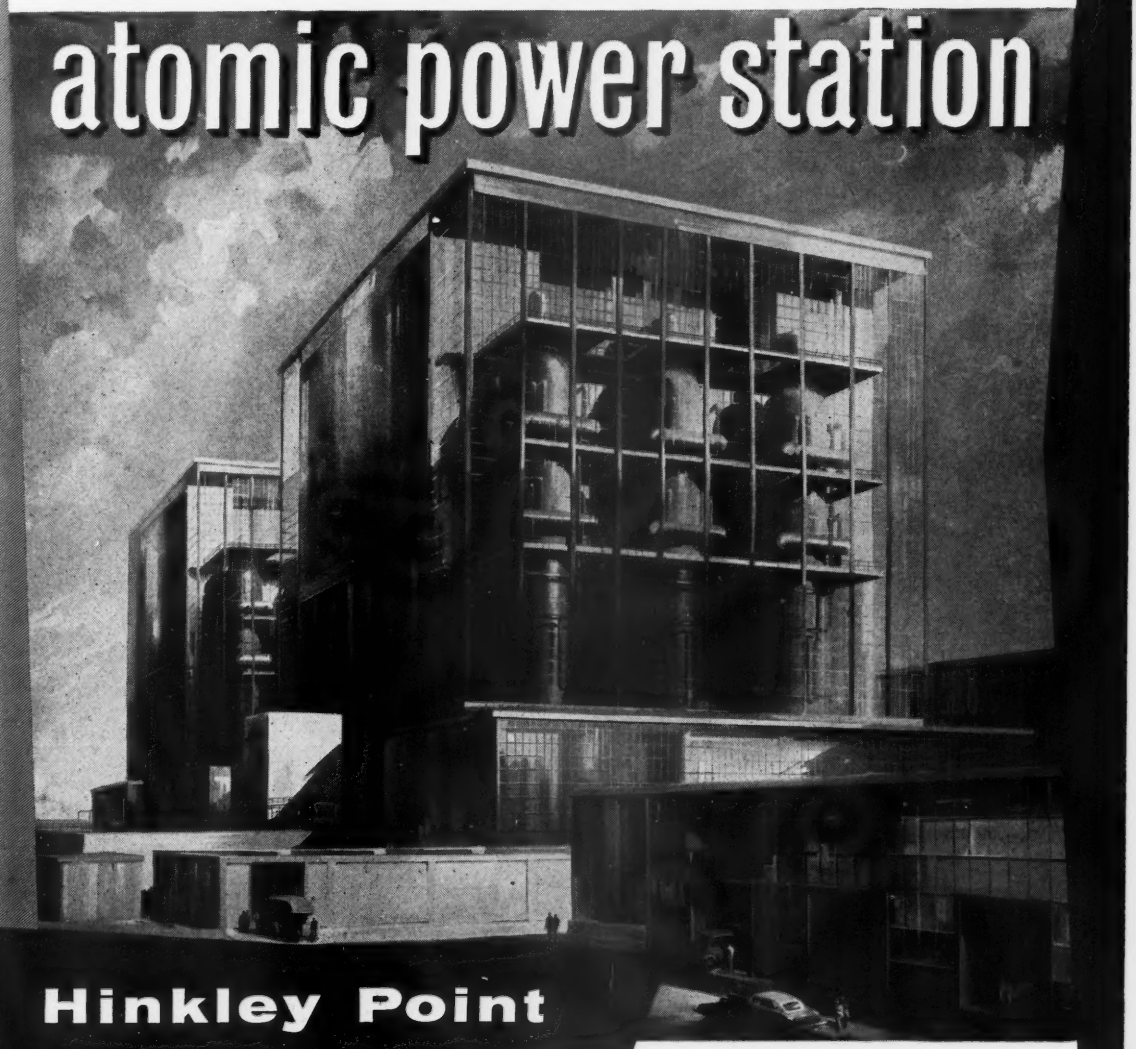
SOUTH WEST SCOTLAND

. . . for all electrical installations
F. H. WHEELER (Scotland) LTD.
144-6 North Street, Glasgow
Telephone: Central 2921

Applications for particulars of costs and standard style of advertisements in this Regional Guide should be addressed to :

THE
ADVERTISEMENT DEPARTMENT,
ELECTRICAL REVIEW,
DORSET HOUSE, STAMFORD STREET,
LONDON, S.E.1

first 500,000 kW atomic power station



Hinkley Point

A GREAT STEP FORWARD...

The 500,000 kilowatt atomic power station for the Central Electricity Authority at Hinkley Point, Somerset, will be built by the ENGLISH ELECTRIC, BABCOCK & WILCOX, TAYLOR WOODROW Group which has also been responsible for evolving, in association with the Central Electricity Authority, the advanced design of this new station. It is by far the largest atomic power station yet ordered by the Authority, and will be the largest in the world.

It represents a momentous step forward in Britain's vitally important programme of atomic power development.

The advance to a 500,000 kilowatt atomic power station, which approaches in capacity the largest of Britain's modern power stations using conventional fuels, has been rapid. It is an impressive technical achievement involving far more than a simple increase in size, made possible by the ability of this team of famous engineers to draw upon a vast fund of design and constructional experience, working in full collaboration with the Atomic Energy Authority.

ENGLISH ELECTRIC

BABCOCK & WILCOX

TAYLOR WOODROW

Meccano Ltd. use a G.E.C. infra-red plant for stoving paint on 'Dinky Toys'

Every week tens of thousands of 'Dinky Toys' pass through this G.E.C. infra-red paint stoving plant installed in the Speke Factory of Meccano Ltd.

Toy double decker buses being sprayed with second colour.

For efficient process heating use

G.E.C.

The finishing of 'Dinky Toys' involves the stoving of paint in a variety of colours on a wide range of models. The problem is met with a G.E.C. infra-red plant in which the heated length, heating intensity and conveyor speed can all be varied. The efficiency and versatility of G.E.C. infra-red plant have led to its adoption for stoving paint on products ranging from toys to complete and complex machinery.

FURNACES • HIGH FREQUENCY • INFRA-RED

THE GENERAL ELECTRIC CO. LTD., MAGNET HOUSE, KINGSWAY, LONDON, W.C.2

Classified Advertisements

CLASSIFIED advertisements are **PREPAID** at 3/6 per line (approx. 6 words) per insertion. Where an advertisement includes a Box Number there is an additional charge of 1/-.

DISPLAYED CLASSIFIED:—48/- per inch. Cheques and Postal Orders should be crossed and made payable to ELECTRICAL REVIEW PUBLICATIONS LTD.

SERIES DISCOUNTS for consecutive insertions:—13, 5%; 26, 10%; 52, 15%.

SITUATIONS WANTED:—Three insertions under this heading can be obtained for the price of two if ordered and prepaid with the first insertion.

REPLIES to Box Numbers should be addressed to the Box Number in the advertisement, c/o ELECTRICAL REVIEW, Dorset House, Stamford Street, London, S.E.1, but if not to be delivered to any particular firm or individual they should be accompanied by instructions to this effect, addressed to the Manager of the ELECTRICAL REVIEW. Replies in such cases cannot be returned. The name of an advertiser using a Box Number will not be disclosed.

ADVERTISEMENTS are accepted up to First Post on Monday of the week of issue and should be addresssed to ELECTRICAL REVIEW, Classified Advertisement Department, Dorset House, Stamford Street, London, S.E.1.

Original testimonials should not be sent with applications for employment

OFFICIAL NOTICES, TENDERS, ETC.

GOVERNMENT OF MALTA

Sewerage: Marsa Pumping Station

Contract No. 1

TENDERS are invited by the Maltese Government for the supply and complete erection of sewage pumping plant for the Marsa Pumping Station on the island of Malta. The plant required comprises 4 vertical spindle pumps each rated at about 3,750 g.p.m., complete wtih motors, starters, switchgear, instruments and pipework, etc.

Tender documents and drawings may be obtained at the office of the Treasurer, The Palace, Valletta, Malta, or at the offices of the Engineers, Messrs. Binnie, Deacon & Gourley, Artillery House, Artillery Row, Westminster, London, S.W.1, on payment of two pounds for each copy of the documents.

Sealed tenders in duplicate in a plain envelope endorsed "Tender for Sewage Pumping Plant" shall be delivered at the office of the Treasurer, The Palace, Valletta, Malta, not later than 10 a.m. on Monday, 2nd December, 1957.

The Maltese Government do not undertake to accept the lowest or any tender, and will not defray any expenses incurred by the contractor in tendering.

THE TREASURER, MALTA.

734

BURGH OF LARGS

Proposed Extension of Trunk Road Lighting

THE Town Council of the Burgh of Largs, having received approval from the Scottish Home Department to a scheme for the extending of the street lighting of Trunk Road A.78 by Sodium Vapour Electric Discharge Lamps, will shortly be in a position to issue specification and schedule of quantities. In all, 14 new lighting points are to be erected.

Firms desirous of tendering are requested to forward their names to George Arkieson, Esq., Lighting Inspector, Municipal Chambers, Largs, not later than 9th October, 1957.

JOHN G. YOUNG,
Municipal Chambers, Town Clerk.
Largs.
24th September, 1957. 696

ORMSKIRK URBAN DISTRICT COUNCIL

Group "A" Sodium Street Lighting

TENDERS are invited for the supply, delivery and erection of 10 Concrete Columns, Lanterns, 140-watt Sodium Lamps, Switch Gear and auxiliary equipment.

Specification and schedule of materials and works may be obtained from the Surveyor. Tenders in plain sealed envelopes marked "Street Lighting" to be returned to the undersigned not later than 10 a.m. on Monday, the 21st October, 1957. Lowest or any tender not necessarily accepted.

JOSIAH TAYLOR,
Council Offices, Clerk of the Council.
Burscough Street,
Ormskirk. 697

CLASSIFIED ADVERTISEMENTS

ARE PREPAID

BOROUGH OF SCUNTHORPE

Street Lighting: Sheffield-Grimsby Trunk Road (A.18) from Ville Road to Brigg Road

TENDERS are invited for the supply only of 28 25-ft. Reinforced Concrete Columns, Sodium Discharge Lanterns and auxiliary gear.

Contract documents may be obtained from the office of the Borough Surveyor, Mr. Cyril Cooper, M.I.C.E., Laneham Street, Scunthorpe, on payment of a returnable deposit of £2 2s.

Tenders in the envelopes provided must be received by the undersigned by 12 noon on Tuesday, 22nd October, 1957.

T. M. LISTER,
Municipal Offices, Town Clerk.
34, High Street, Scunthorpe.
24th September, 1957. 728

SITUATIONS VACANT

ENGINEERING IN THE CHEMICAL INDUSTRY?

WHY is the Chemical Industry of interest to the Engineer? Firstly, because it uses a wider selection of engineering plant and equipment than any other branch of industry; secondly, because the problems which it has to tackle are such that their solution depends as much on the Engineer as on the Chemist. The industry is expanding rapidly and at

IMPERIAL CHEMICAL INDUSTRIES LIMITED, WILTON WORKS

over 4,700 men are working on the design and construction of the largest single project in Britain's chemical history. Wilton Works is a manufacturing centre, with its own power station, where any Division of I.C.I. can build and operate production units. Twenty-one plants are in operation to-day, and included in these are "Perspex," "Terylene" and Titanium. The number of

MECHANICAL, ELECTRICAL AND INSTRUMENTATION ENGINEERS

required for design, construction, operation and work study is steadily increasing as the works continue to grow.

Salaries depend on ability and experience and are reviewed annually after appointment. Promotion is by merit alone and individuals are considered at regular intervals. Help will be given with housing and removing, and a lodging allowance will be paid for a period to married men selected for these appointments whilst maintaining two homes. The design offices are pleasantly situated in the parklands of Wilton Castle, which lies at the foot of the Cleveland Hills.

Suitable applicants, who should possess an honours degree, will be invited for interview at the company's expense.

Please write to the

Staff Manager
IMPERIAL CHEMICAL INDUSTRIES LTD.
Wilton Works, Middlesbrough, Yorkshire

quoting 427/6.

749

SOUTH EASTERN ELECTRICITY BOARD

METER TESTER or METER TESTER'S ASSISTANT, Central Meter Dept., Croydon.

Meter Tester, wages 4s. 11½d. per hour; Meter Tester's Assistant, wages 4s. 6½d. per hour, for a 44-hour 5-day week under the N.J.I.C. agreement.

Applications, naming two referees, to T. A. D. Honnor, M.I.E.E., Croydon and West Kent Area Manager, SEEBOARD, Electric House, Wellesley Road, Croydon, by 14th October, 1957.

ASSISTANT DISTRICT ENGINEERS, within the Surrey Sub-Area.

N.J.B. Class F, Grade 7. Dorking and Epsom District and in the Sutton District. Salary £885 × £15 to £930 p.a. plus, in the case of the Sutton appointment, London allowance. Superannuable.

Applicants should be Corporate Members of the Institution of Electrical Engineers or hold a Higher National Certificate in Electrical Engineering, and in addition should have had training and experience in the planning, construction, operation and maintenance of underground and overhead distribution systems, preferably up to 33 kV.

N.J.B. Class F, Grade 9. Woking District. Salary £790 × £15 to £835 p.a. Superannuable.

Applicants, of good general education, should be technically trained up to Higher National Certificate standard with practical experience of distribution work on H.V. and L.V. systems. Ability to plan and prepare schemes for mains extensions would be an advantage.

N.J.B. Class F, Grade 11. Dorking and Epsom District and in the Sutton District. Salary £685 × £15 to £730 p.a. plus, in the case of the Sutton appointment, London allowance. Superannuable.

Applicants, preferably of at least Higher National Certificate standard, should have had a sound training and experience in the construction, operation and maintenance of underground and overhead distribution systems.

Applications, naming two referees, on forms from C. W. Hughes, B.Sc., M.I.E.E., Surrey Manager, SEEBOARD, Rough Rew, Ridgeway Road, Dorking, Surrey, by 16th October, 1957.

A. L. BURNELL,
Secretary. 742

EAST MIDLANDS ELECTRICITY BOARD

Second Assistant District Engineer, Lincoln District, Lincolnshire Sub-Area

APPLICATIONS are invited from suitably qualified and experienced engineers for the appointment of SECOND ASSISTANT DISTRICT ENGINEER in the Lincoln District of the Lincolnshire Sub-Area.

The salary and conditions of the appointment will be in accordance with the National Joint Board Agreement, Class F, Grade 7 (£885/£930 per annum).

Duties will consist of assisting in the construction, operation and maintenance of overhead and underground distribution systems up to and including 11 kV. Ability to drive a motor vehicle, and the possession of a current driving licence, is essential and the successful candidate will be expected to undertake standby duties.

Applications stating age, details of education, experience, present appointment and qualifications, should be forwarded to the District Manager at Brayford Side North, Lincoln so as to reach him within fourteen days of the date of this advertisement. 744

Situations Vacant (continued)

CENTRAL ELECTRICITY AUTHORITY

East Midlands Division

APPLICATIONS are invited for the following vacancies in this Division :—

ASSISTANT SHIFT CHARGE ENGINEER, BURTON-ON-TRENT POWER STATION
(Vacancy No. 168/57/ER).

Applicants should have H.N.C. or equivalent qualifications and have experience in power station operation.

Salary will be in accordance with Class E, Grade 9 (£740-£785 per annum) of the National Joint Board Agreement.

Closing date for receipt of applications, 16th October, 1957.

ASSISTANT ENGINEER (Instruments), WILLINGTON "A" POWER STATION
(Vacancy No. 170/57/ER).

Candidates should have had a sound technical training and have a good practical knowledge of the construction, repair and testing of power station instruments and automatic controls.

Salary will be in accordance with Class K, Grade 10 (£935 - £995 per annum) of the National Joint Board Agreement.

Closing date for receipt of applications, 16th October, 1957.

THIRD ASSISTANT ENGINEERS (Mechanical), GENERATION (Construction) DEPT., CASTLE DONINGTON POWER STATION SITE
(Vacancy No. 171/57/ER).

Applicants should have had a fundamental training in mechanical engineering, including workshops, and should preferably have had experience in the manufacture, erection, maintenance and operation of mechanical plant as installed in modern power stations. Preference will be given to candidates who possess a degree or are Graduate Members of the Institution of Mechanical Engineers.

Salary will be within Class AX/EX, Grade 4 (£895-£1,140 per annum) of the National Joint Board Agreement.

Closing date for receipt of applications, 16th October, 1957.

SHIFT CHARGE ENGINEER, BURTON-ON-TRENT POWER STATION
(Vacancy No. 177/57/ER).

Sound technical training and practical experience in the control and operation of steam generating plant and main switchgear are required. Appropriate qualifications an advantage.

Salary in accordance with Class E, Grade 7 (£835-£880 per annum) of the National Joint Board Agreement.

Closing date for receipt of applications, 23rd October, 1957.

FIRST ASSISTANT CHEMIST, WILLINGTON "A" POWER STATION
(Vacancy No. 176/57/ER).

Candidates must have had previous experience in a power station laboratory and should preferably be qualified for admission to the Associateship of the Royal Institute of Chemistry ; consideration will however be given to suitably experienced holders of the Higher National Certificate in Chemistry.

Applicants must be familiar with the routine methods of sampling and analyses (including physical testing) of coal, oil, water and other materials, and with the interpretation and application of the analytical results.

Salary and conditions of service will be in accordance with the N.J.B. Schedule, Class K, Grade 9 (£995-£1,055 per annum).

Closing date for receipt of applications, 23rd October, 1957.

These appointments will be pensionable within the provisions of the Central Electricity Authority and Area Boards (Staff) Superannuation Scheme.

Applications should be submitted on the official form AE6/ACT, which may be obtained from the Divisional Establishments Officer, Central Electricity Authority, East Midlands Division, P.O. Box 25, Barker Gate, Nottingham, and should be returned to the undersigned by the date stated. PLEASE QUOTE VACANCY NUMBER.

L. F. JEFFREY,
Divisional Controller.

703

WESTERN REGIONAL HOSPITAL BOARD, SCOTLAND

Assistant Engineers

APPLICATIONS are invited for two posts of ASSISTANT ENGINEER for electrical and heating duties respectively. Applicants should be Corporate Members of, or have obtained, the technical standard of Corporate Members of the Institutions of Electrical Engineers or Heating and Ventilating Engineers respectively, and should have practical and theoretical experience of design, installation and operation and general maintenance, and should be capable of assisting in preparing specifications and estimates and advising generally on the classes of plant in their own particular field, viz.:—

(a) ELECTRICAL :
Electrical installation, including heating, lighting and power, and

(b) HEATING :
Heating, ventilating, hot water, air conditioning, refrigerating, sterilising and pipe work installations in large buildings, laundries, kitchens, etc.

Salary scale £680 × £25 (3) × £30 (2) × £35 (1) × £30 (1) × £35 (3) to £985.

Starting salary may be above the minimum having regard to experience.

The successful applicants will be required to pass a medical examination and all appointments are subject to a deduction at the rate of 6% for superannuation.

Applications giving particulars of qualifications and experience, together with the names of three referees, should be lodged with the Secretary, Western Regional Hospital Board, 64, West Regent Street, Glasgow, C.2, not later than 26th October, 1957. 718

IMPERIAL CHEMICAL INDUSTRIES LIMITED

Wilton Works

ENGINEERING DESIGNERS

who possess Higher National Certificate or its equivalent, and have experience in the following branches of engineering :

MECHANICAL, CIVIL,
ELECTRICAL, STRUCTURAL,

are required to fill immediate vacancies in the Design Office working on the development of this 2,000-acre factory site, at which is centred much of the company's large expansion programme.

HOUSING : After joining the staff married men will receive a reasonable refund of removal (including travel) expenses and, to assist them in house purchase, facilities are available in approved cases for substantial loans. In addition, legal charges will be advanced. A lodging allowance will be paid for a period to married men selected for these appointments whilst maintaining two homes.

COMMENCING SALARIES : These vary between £535 and £1,000 per annum according to age, experience and qualifications.

The Design Offices are situated in the parklands of Wilton Castle, which lies at the foot of the Cleveland Hills.

Please write to me : Staff Manager, Imperial Chemical Industries Limited, Wilton Works, Middlesbrough, Yorkshire, quoting reference 428/6.

334

SOUTH WALES ELECTRICITY BOARD

ASSISTANT ENGINEER (Substations) required, District 222 (Neath) in the West Central Sub-Area of the Board.

Salary Class E, Grade 7 (£835/£880) of the N.J.B. Schedule.

Applications stating age, present position and salary, qualifications, experience, and three referees, should be addressed to the Secretary (Establishments Section), St. Mellons, Cardiff, so as to reach him not later than Monday, 14th October, 1957. 672

NORTH WESTERN ELECTRICITY BOARD

FOURTH ASSISTANT DISTRICT ENGINEER,
ROCHDALE DISTRICT.

The duties include assisting with the operation, maintenance and construction of the underground and overhead distribution system at all voltages, 33 kV and below. The successful applicant will be required to undertake standby duties and to reside within the District.

Preference given to applicants in possession of suitable qualifications.

Salary scale £740 × £15 to £785 p.a., Grade G.11. N.J.B. conditions.

Applications, naming three referees, to the Sub-Area Manager, No. 3 Sub-Area, North Western Electricity Board, Union Street, Oldham, by 12th October, 1957.

ASSISTANT (Mains Records), SUB-AREA ENGINEER'S DEPARTMENT, BLACKBURN.

Applicants should have had extensive experience in the measurement of underground mains and overhead line positions on site, and the recording of these on the mains records plans.

The successful candidate will be required to take charge of and be responsible for the mains records in the District.

Salary scale £615 × £20 to £675 p.a., Grade 2. N.J.C. conditions.

Applications, naming three referees, to Sub-Area Manager, No. 5 Sub-Area, North Western Electricity Board, Jubilee Street, Blackburn, by 12th October, 1957.

(a) METER TESTER, BLACKPOOL.
(b) METER REPAIRER (Mechanician), BLACKPOOL.

Applicants for (a) must have previous experience in the testing of A.C. credit and prepayment house service pattern meters. Experience in polyphase meter testing will be an advantage.

Wages and conditions N.J.I.C. Present rate (both posts) 55.5od. per hour, equivalent to £10 3s. 6d. for a 44-hour, 5-day week.

Applications to the District Commercial Engineer, North Western Electricity Board, 4D South West Fylde District, Shannon Street, Blackpool, by the 12th October, 1957. 698

SOUTH WALES SWITCHGEAR LIMITED

Blackwood, Mon.

WE invite applications from capable young men possessing drive and initiative for the following positions in our rapidly expanding organisation. Candidates should preferably possess a Higher National Certificate or equivalent qualification, but good experience in one or more of the following fields is considered to be of prime importance.

DESIGN DRAUGHTSMEN.

Experienced in the design of H.V. switchgear and associated equipment.

CONTRACTS DRAUGHTSMEN.

With experience in the application and layout of switchgear in one or more of the following fields : Outdoor and indoor substations, power station and industrial switchgear, generator busbar trunking.

DIAGRAMS DRAUGHTSMEN.

Experienced in the layout and detail of protective and control systems, etc., covering all types of switchgear applications.

The vacancies occur in a modern factory, located in pleasant surroundings within easy access of Cardiff and Newport.

Applications, which will be treated in the strictest confidence, should be addressed to the

PERSONNEL MANAGER.

614

EASTERN ELECTRICITY BOARD

APPLICATIONS are invited for the following appointments. The successful candidates will be required to contribute to a superannuation scheme and may be required to undergo a medical examination.

Chilterns Sub-Area Headquarters, Bedford

(i) SENIOR DRAUGHTSMAN (126/57.R).
(ii) ENGINEERING DRAUGHTSMAN (127/57.R).

Candidates for (i) should have had experience of building and civil engineering work for substations, service centres, workshops, offices, etc.

The successful candidate will be required to supervise staff engaged on the preparation of drawings, be capable of the design of simple reinforced concrete structures and be able to carry out site surveys.

Candidates for (ii) should have had a good general and technical education and should preferably be experienced in substation design, layout of equipment and the preparation of plans and detailed drawings of buildings and civil engineering works.

Salary (i) N.J.B. Schedule D, Grade 5 (£760-£860).
(ii) N.J.B. Schedule D, Grade 6 (£595-£715).

For both appointments apply by letter, within 14 days, to S. F. C. Whitmore, A.M.I.E.E., Manager, Chilterns Sub-Area, Eastern Electricity Board, Prebend Street, Bedford.

Northmet Sub-Area, Enfield District

TWO GENERAL ASSISTANT ENGINEERS (Ref. 744) (128/57.R).

Candidates should have had a good general and technical education and possess the Higher National Certificate or an equivalent qualification.

Salary N.J.B. Class F, Grade 13 (£590-£635) plus London allowance.

Apply by letter to F. H. Long, M.I.E.E., M.Amer.I.E.E., Manager, Eastern Electricity Board, 40, Church Street, Enfield, by 14th October, 1957. 740

DOMESTIC APPLIANCES

THE European Free Trade Area offers a fresh challenge to engineers capable of designing and developing new electric ranges, refrigerators and washing machines with improved performance at lower cost.

In this context the

ENGLISH ELECTRIC CO.

seek to reinforce their design team in three ways.

FIRST by the appointment of a

SENIOR ENGINEER

experienced in the art and possessing, in addition to high-class professional qualifications, a full measure of initiative, enthusiasm and leadership.

SECOND to support the senior engineers and to train for more senior positions, applications are invited from

JUNIOR ENGINEERS AND DRAUGHTSMEN.

Such applicants must possess the appropriate technical qualifications, but experience in related consumer product fields such as automobile engineering will be accepted.

THIRDLY by the recruitment of

AMBITIOUS YOUNG MEN

just leaving university, grammar school or technical school, who seek an opportunity for exercising their creative talent, not only as members of the team, but also as individuals.

All positions are permanent and pensionable and offer good working conditions in a most modern and well-equipped factory.

Generous assistance is available to successful applicants regarding the provision of housing.

Please write to Dept. C.P.S., 336/7, Strand, London, W.C.2, quoting Ref. ER.405C.

676

MIDLANDS ELECTRICITY BOARD

APPLICATIONS are invited for the following superannuable posts:—

North Staffordshire Sub-Area

SENIOR ASSISTANT (Education and Training), Sub-Area Headquarters.

Duties will include the implementation and administration throughout the sub-area of the Board's educational and training schemes for all personnel. Applicants should have had experience of the administration of training schemes and in particular craft and student apprenticeships. The possession of an appropriate professional qualification or university degree will be considered an advantage. Salary £945/£1,020 per annum (N.J.C. Grade 6).

Apply by letter, within fourteen days, stating age, education, experience, present position and salary to Mr. H. A. P. Caddell, Sub-Area Manager, Midlands Electricity Board, 234, Victoria Road, Fenton, Stoke-on-Trent.

Central Gloucestershire Sub-Area

SECOND ASSISTANT DISTRICT ENGINEER (Severn Vale District).

Duties involve the construction, maintenance and operation of E.H.V. and L.V. mains and substations and planning system reinforcements and mains extensions. Technical qualifications desirable. Salary £835/£880 per annum (N.J.B. Grade E.7).

Apply by letter, within fourteen days, stating age, experience, present position and salary to Mr. S. Raybould, Sub-Area Manager, Midlands Electricity Board, 126, London Road, Gloucester.

A. STEPHENS,
Secretary.

739

AUTOMATIC TELEPHONE & ELECTRIC COMPANY LIMITED

SCHOOL OF ELECTRONICS

APPLICATIONS are invited for the following appointments in the School of Electronics of the Automatic Telephone & Electric Company Limited, Liverpool.

SENIOR LECTURER, One post.
LECTURER, Two posts.

The work is postgraduate in nature, and involves lecturing on modern electronic technique as applied to communication engineering.

Candidates should possess an honours degree in either

(a) Electrical engineering, with electronics or telecommunications.
(b) Physics, with electronics and/or mathematics.

Salaries will be in accordance with the Burnham Technical Scale. Persons appointed will be required to join the company's superannuation scheme. Assistance can be given with housing in suitable cases.

Application forms and details may be obtained from :—

The Personnel Manager
AUTOMATIC TELEPHONE & ELECTRIC CO. LTD.
Strowger Works, Liverpool, 7

730

YOUNG ENGINEERS

interested in gaining experience of the erection of lattice tower, concrete and wood pole overhead transmission lines and willing to serve either at home or overseas. Technical background up to H.N.C. (Electrical) standard desirable, but previous experience of this kind of work not essential. Pension fund.

Write giving full particulars and quoting reference C/76/55 to Staff Officer, British Insulated Callender's Construction Company Limited, 30, Leicester Square, London, W.C.2.

174

MERSEYSIDE AND NORTH WALES ELECTRICITY BOARD

THIRD ASSISTANT COMMERCIAL ENGINEERS required at No. 1 Sub-Area Headquarters, Liverpool. Salary within range £995/£1,055 per annum (N.J.B. L/10).

Applicants should have had wide experience in the industrial and commercial applications of electricity, and be capable of advising on and estimating for the provision of supply to large consumers. Good technical qualifications essential.

Applications on special forms obtainable from the Manager, No. 1 Sub-Area, 24, Hatton Garden, Liverpool, 3.

ASSISTANT CONSUMERS' ENGINEERS required in the following districts :—

Liverpool Central :
Salary £835/£880 p.a. (N.J.B. J/11).
Liverpool North :
Salary £790/£835 p.a. (N.J.B. H/11).
Liverpool South :
Salary £790/£835 p.a. (N.J.B. H/11).

Duties include estimating for contracting work and advising consumers on electricity supply matters and on normal applications of electricity.

Applicants should preferably have at least the Ordinary National Certificate in Electrical Engineering or equivalent qualification.

Standard application forms to be forwarded to the Manager, No. 1 Sub-Area, 24, Hatton Garden, Liverpool, 3.

All above appointments subject to medical examination. Pension scheme.

Closing date for all applications, 14th October, 1957. 705

Applications are invited by

SIMPLEX ELECTRIC COMPANY LIMITED

for engineers to join their

CREDA DESIGN CENTRE

in London (adjacent Alperton Underground Station). These vacancies present genuine opportunities for original work and the backing of a large well-equipped production plant. Present requirements are for :—

SENIOR DESIGNERS with experience of cookers or water heaters or other appliances. Applicants should have broad experience and be capable of taking responsibility for major developments.

DRAUGHTSMEN with experience of domestic appliances and sound knowledge of design for modern production methods.

SENIOR DEVELOPMENT ENGINEERS with a record of successful projects in the design of motorised or static domestic appliances.

Written applications with full details of industrial experience to date and salary expected will be received in strict confidence by the Secretary, Simplex Electric Company Ltd., Oldbury, Birmingham. Interviews can be arranged in London or Birmingham.

594

CENTRAL ELECTRICITY AUTHORITY

Midlands Division

FOURTH ASSISTANT ENGINEER is required in the Birmingham Section of the Transmission Department. N.J.B. service conditions, superannuable appointment, salary within Schedule B, Grade 6, commencing in the range £710 to £835 and ultimately rising to £935 per annum.

Applicants should possess Higher National Certificate in Electrical Engineering or equivalent, and should have had experience in the operation and maintenance of high-voltage transmission lines and substations.

Apply, quoting vacancy number 649MD, on form AE6, available from the Establishments Officer, 53, Wake Green Road, Moseley, Birmingham, 13, by 16th October, 1957. 717

Situations] Vacant (continued)

GOVERNMENT OF BAHRAIN

State Medical Department

A MECHANICAL/ELECTRICAL ENGINEER to take charge of the installation, maintenance and operation of all electrical and mechanical services and equipment for a large new hospital in a rapidly expanding department.

Preference will be given to candidates between 26/40 year of age holding at least an Ordinary National Certificate in Electrical/Mechanical Engineering, having held a similar appointment for at least five years.

Consolidated commencing salary up to £148 per month, according to qualifications and experience. There is also a pension fund.

Free bachelor quarters, with hard furnishings only, and medical attention provided. Married accommodation provided after satisfactory completion of six months' probationary period. Contract in the first place for a period of two years, subject to six months' probation. Leave is granted every two years at the rate of ten weeks per annum. Free passages by air to and from London, U.K., are provided for the applicant and his wife every two years.

Applications giving full details of qualifications, training and experience to be addressed to the Personnel Officer, Ewbank & Partners Ltd., 10/11, Grosvenor Place, London, S.W.1.

720

ENGINEER FOR COMMISSIONING AND TESTING DEPARTMENT

CANDIDATES for this post must produce evidence that their past experience is such as will fit them to take complete charge of the commissioning of modern power plant (mechanical) and of its subsequent operation until taken over by the client.

The duties of the successful candidate, in the first place, will be abroad, but subsequently he will be attached to the London office with absences from London for periods up to six months at a time. A knowledge of testing technique as applied to boilers, turbines, cooling towers, dust collectors and auxiliary plant is desirable.

The minimum age requirement is 35 years, and while good technical qualifications are highly desirable, the lack of such qualifications will not necessarily debar a candidate.

ENGINEER FOR TECHNICAL ENGINEERING DEPARTMENT

Duties are the preparation of general schemes for and detailed engineering of new thermal and nuclear energy power plants, both industrial and central, and the technical analysis of existing plants. Candidates will be expected to provide evidence that their technical and practical background is such as will enable them to assess correctly a client's plant requirements and also to determine the suitability of plant offered by a manufacturer. The work involves a knowledge of thermodynamics, fluid flow mechanics, physics, and the application of these to power plant problems; for these reasons the possession of a good technical qualification in engineering is desirable. The successful candidate will be centred in London but will be expected to undertake short visits to plant sites as required.

Applications giving details of training, qualifications and experience to date for the above positions should be sent to the Personnel Officer, Ewbank and Partners Limited, 10/11, Grosvenor Place, London, S.W.1.

721

BRITISH KLOCKNER SWITCHGEAR LIMITED

Chertsey, Surrey

ESTIMATOR for TECHNICAL SALES. Correspondence and capable of preparing control schemes involving automatic motor control gear. Experience essential.

CIRCUIT DIAGRAM DRAUGHTSMAN. Preferably experienced in preparing automatic control gear schemes.

Applicants to have O.N.C. (Electrical). Excellent opportunities with fast growing concern. Pension scheme. Apply to Managing Director, stating experience and present salary.

165

BRITISH ELECTRICAL DEVELOPMENT ASSOCIATION

APPLICATIONS are invited for the following appointments :—

(a) CHIEF TECHNICAL OFFICER.

Applicants should possess a sound technical training, including University Degree in Science or Engineering and/or Corporate Membership of the Institution of Electrical Engineers, and have general experience in the supply and utilisation of electricity for all purposes in domestic and commercial premises, industry and farms. Advertising or publicity experience will be an advantage. Salary within range £2,000-£2,500, according to experience and qualifications.

(b) INDUSTRIAL ELECTRIC HEATING ENGINEER.

Applicants should have experience of various types of industrial electric heating equipment, including furnaces, resistance heaters and high-frequency heaters, and of their practical application in factories and works. It will be an advantage for candidates to possess a University Degree in Science or Engineering. Salary within range £1,300-£1,600, with starting point according to experience and qualifications.

Applications stating age, qualifications and experience, and salary required should be addressed, not later than 16th October, to the Director and Secretary, British Electrical Development Association, 2, Savoy Hill, London, W.C.2.

577

MICHELIN TYRE CO. LTD.

Stoke-on-Trent

have a progressive opening for a

DESIGNER/DRAUGHTSMAN
(Electrical)

preferably with Grad. I.E.E. or H.N.C. and experience in three of the following fields desirable :—

1. Motor and control gear application, A.C. and D.C.
2. E.H.T. and L.T. distribution and cable work.
3. Lighting schemes.
4. Substation design and layout.
5. E.H.T. and L.T. oil and air brake switch gear.

Commencing salary according to qualifications and experience. Contributory pension scheme, free life assurance and excellent welfare and recreational facilities.

Assistance with housing will be given if required.

Please write in confidence to Mr. Glendenning, c/o the above, quoting reference B/ER.

688

NORTH EASTERN ELECTRICITY BOARD

York Sub-Area

APPLICATIONS are invited for the following appointments:—

(1) SECOND ASSISTANT DISTRICT ENGINEER, Malton. Applicants should have had experience of E.H.V. and H.V. systems supplying urban and rural networks and of the supervision of construction work done by direct labour or contractors. Salary Schedule A, Class D, Grade 7, £790/£835 per annum. N.J.B. conditions of service.

(2) FOURTH ASSISTANT ENGINEER, Sub-Area Headquarters, York. Applicants should have had experience of the operation, maintenance and construction of public lighting installations. Salary Schedule A, Class G, Grade 12, £685/£730 per annum. N.J.B. conditions of service.

Applications stating age, qualifications and experience to be received by the Assistant Secretary (Establishments), North Eastern Electricity Board, G.P.O. Box No. 117, Carliol House, Newcastle upon Tyne, within ten days of the appearance of this advertisement.

745

EAST MIDLANDS ELECTRICITY BOARD

Third Assistant District Engineer and Fourth Assistant District Engineer, Burton District, Derby and Burton Sub-Area

APPLICATIONS are invited for the above appointments in the Planning and Development Section, Burton District of the Derby and Burton Sub-Area.

The duties will consist of assisting with the planning and construction of underground and overhead distribution systems up to and including 11 kV. For the senior appointment, the successful applicant may be required to undertake standby duties and to reside in or near Burton.

The salaries and conditions of appointment will be in accordance with the National Joint Board Agreement, as follows :—

Third Assistant District Engineer :
Class F, Grade 9 (£790×£15 to £835 p.a.)

Fourth Assistant District Engineer :
Class F, Grade 11 (£685×£15 to £730 p.a.)

Applications stating age, details of education, experience, present appointment and qualifications should be forwarded to the Manager, Burton District, Derby and Burton Sub-Area, Horninglow Street, Burton-on-Trent, so as to reach him within fourteen days of the date of this advertisement.

700

SECTION LEADER (ELECTRICAL DRAWING OFFICE)

required by

THE STEEL COMPANY OF WALES LTD.

(Steel Division), Port Talbot.

The successful candidate will be expected to take charge and supervise an office of fifteen electrical draughtsmen. He should have experience in heavy industry and be capable of preparing drawings for electrical installations, including the layout of substations and contactor rooms. A knowledge of lighting and communications would be an advantage.

Higher National Certificate or equivalent desirable.

Those wishing to apply should write, giving full details of age, experience, qualifications and present salary, quoting the reference 215/ER, to—

Superintendent, Personnel Services
THE STEEL COMPANY OF WALES LTD.
Abbey Works, Port Talbot, Glam.

675

EAST MIDLANDS ELECTRICITY BOARD

Third Assistant District Engineer Wellingborough District Northamptonshire Sub-Area

APPLICATIONS are invited for the position of THIRD ASSISTANT DISTRICT ENGINEER in the Wellingborough District of the Northamptonshire Sub-Area.

The salary and conditions of the appointment will be in accordance with the National Joint Board Agreement, Class E, Grade 9 (£740 × £15 to £785 per annum), and a rented house will be available.

Candidates should preferably possess a technical qualification equivalent to the Higher National Certificate in Electrical Engineering, and have had experience in the construction, operation and maintenance of overhead and underground distribution systems up to and including 11 kV.

The successful candidate must be able to drive a motor vehicle and may be required to undertake standby duties.

Applications stating age, education, qualifications and experience, with details of present position and salary, should be addressed to the Manager, Northamptonshire Sub-Area, 25, Bridge Street, Northampton, to reach him within fourteen days of the date of this advertisement.

743

A. REYROLLE & COMPANY LTD. HEBBURN

have vacancies in their RESEARCH DEPARTMENT for the following staff to deal with an expansion of the work in the laboratories :—

1. UNIVERSITY GRADUATES, preferably with Hons. Degree in Electrical Engineering or Physics, to undertake research into problems relating to power systems, switchgear, protective gear, dielectric phenomena and insulating materials.
2. MEN WITH A PASS DEGREE OR H.N.C. IN ELECTRICAL OR MECHANICAL ENGINEERING, to undertake general technical work and co-ordination of development testing relating to the above and other problems.

Reyrolle are among the largest switchgear manufacturers in the world and their work covers a wide field. The appointments advertised are in accordance with usual staff conditions, and offer interesting work with good prospects, at salaries commensurate with qualifications and experience. Assistance may be given with housing.

Write in confidence with full particulars to the Chief Engineer, A. Reyrolle & Co. Ltd., Hebburn, Co. Durham. 722

M.K. ELECTRIC LIMITED

are enlarging their Sales Force in the North and

REQUIRE ADDITIONAL REPRESENTATIVES

for parts of Lancashire and Yorkshire.

If you have experience in dealing with architects, electrical wholesalers and contractors, are a car owner, and would like to join the sales team of a progressive company marketing products with a world-wide reputation, we would like to hear from you in confidence.

Write in the fullest detail to—

The Sales Manager
M.K. ELECTRIC LTD.
Wakefield Street
London, N.18

687

'ENGLISH ELECTRIC'

London, S.W.1
Transformer Drawing Office

GOOD TRANSFORMER DRAUGHTSMEN as well as MECHANICAL DRAUGHTSMEN are required for work on the heavier range of transformer manufactured by the company (30 MVA—350 MVA).

These are permanent staff appointments carrying excellent salaries and offering opportunity for advancement within the Group to men who wish to progress.

This new office is pleasantly appointed in a modern office block 5 minutes from Victoria Station.

There are also attractive openings for JUNIOR DRAUGHTSMEN in this office.

We would also like to hear from Senior and Junior Draughtsmen interested in similar work at our STAFFORD works.

Please write giving full details to Central Personnel Services, 336/7, Strand, London, W.C.2, quoting Ref. ER.1299B.

695

CITY OF SALISBURY, SOUTHERN RHODESIA

Vacancy for Traffic Control Electrician

APPLICATIONS are invited from suitably qualified persons for the vacancy of TRAFFIC CONTROL ELECTRICIAN.

Candidates must have experience of and be capable of carrying out all work on electrical street traffic control equipment.

Wages are £21 12s. for a 48-hour week. No cost-of-living or other allowances are payable and overtime is at prescribed rates.

The successful applicant must comply with the requirements of the Immigration Authorities and will be required to submit to the Council a satisfactory medical certificate of fitness.

Applicants should submit full particulars of their qualifications, training and experience, giving details of positions held, age, nationality, place of birth and marital state. Copies of not more than three recent testimonials may be attached.

Forms of application and further particulars may be obtained from Davis & Soper Ltd., 52 and 54, St. Mary Axe, London, E.C.3, to whom applications should be sent to arrive not later than 18th October, 1957. 654

SOUTH OF SCOTLAND ELECTRICITY BOARD

APPLICATIONS are invited for the position of THIRD ASSISTANT ENGINEER (Civil) in the Distribution/Construction Section of the Chief Engineer's Department at Board Headquarters.

Applicants should have passed Sections A and B of the Institute of Civil Engineers' Examination, or have equivalent qualifications, and should have some years' practical experience of site supervision. Experience of the survey and construction of steel tower overhead transmission lines is also required.

Salary, N.J.B. Schedule B, Class AX/DX, Grade 4, £895/£1,110 per annum. The position is superannuable.

Applications should be made on the standard application form, which can be obtained from the undersigned, and returned to this office not later than Friday, 25th October, 1957. Please quote Reference No. E48/57.

ANDREW A. WALLACE,
Secretary.
P.O. Box 173,
351, Sauchiehall Street,
Glasgow, C.2.
26th September, 1957. 747

BRITISH THOMSON-HOUSTON CO. LTD.

THE BRITISH THOMSON-HOUSTON Co. Ltd. has a vacancy for a GRADUATE PHYSICIST or ELECTRICAL ENGINEER who is free from National Service obligations in their Research Laboratory at Rugby, to assist in the development and evaluation of insulation for medium and high-voltage applications. The work covers a wide and interesting field and includes the determination of the physical properties of materials and the development and functional evaluation of composite insulation. Previous experience of this type of work is not essential.

Applicants are invited to write to the Director of Research, The British Thomson-Houston Co. Ltd., Rugby, giving particulars of education and experience, and quoting reference SR7.

563

AIR MINISTRY

require civilian DRAUGHTSMEN (engineering) at Henlow, Beds., and Medmenham, Bucks. Duties require sound knowledge of electrical engineering. Quals., O.N.C. or equiv., satisfactory completion of normal apprenticeship or equiv. training of not less than three years, and workshop experience.

Salary £550 to £755, on entry depending upon age and exp., rising to maximum of £870. Five-day week and paid leave of 3 weeks and 3 days rising to 6 weeks plus 9 public holidays.

For application form and full particulars apply to Air Ministry, C.E.4h, Cornwall House, Waterloo Road, London, S.E.1. 673

YORKSHIRE ELECTRICITY BOARD

No. 5 (Wakefield) Sub-Area

DONCASTER DISTRICT, THIRD ASSISTANT DISTRICT ENGINEER.

Applicants should have had practical training and experience in the construction, operation and maintenance of H.V. and M.V. overhead and underground distribution networks, substation plant and ancillary equipment.

Candidates should preferably have attained the technical standard of the Higher National Certificate in Electrical Engineering or equivalent qualifications.

Candidates must be prepared to reside in the district and undertake standby duties.

Salary N.J.B. Class F, Grade 9, £790/£15/£835 per annum.

Applications, giving full details of age, qualifications and experience, together with the names of two referees, should be forwarded to the Manager, No. 5 (Wakefield) Sub-Area, Yorkshire Electricity Board, 1a, Denby Dale Road, Wakefield, not later than 18th October, 1957. 741

SOUTH OF SCOTLAND ELECTRICITY BOARD

Dumfries and Galloway Area

Second Assistant Engineer (Planning and Development) at Area Headquarters

APPLICATIONS are invited for the post of SECOND ASSISTANT ENGINEER (Planning and Development) at Area Headquarters. Applicants should have had a sound technical training and some practical experience of system design.

The conditions of service will be regulated by the National Joint Board Agreement and the salary will be in accordance with Schedule A, Class G, Grade 8, £885/£930 per annum. The post is superannuable.

Applications, on the standard form, should be forwarded to the undersigned not later than 16th October, 1957.

W. H. WILLS,
Manager.
Marchmount,
Dumfries. 712

EAST MIDLANDS ELECTRICITY BOARD

Third Assistant District Engineer, Derby District, Derby and Burton Sub-Area

APPLICATIONS are invited for the appointment of THIRD ASSISTANT DISTRICT ENGINEER in the Derby District of the Derby and Burton Sub-Area.

The salary and conditions of the appointment will be in accordance with the National Joint Board Agreement, Class G, Grade 9 (£835/£880 per annum).

The duties will consist of assisting in the construction, maintenance and operation of underground and overhead distribution systems up to and including 11 kV. Experience of similar duties would be an advantage.

The successful candidate will be required to undertake standby duties and reside in or near Derby.

Applications giving details of age, education, experience, present appointment and qualifications should be forwarded to the Manager, Derby and Burton Sub-Area, 36, Full Street, Derby, so as to reach him within fourteen days of the date of this advertisement. 701

CENTRAL ELECTRICITY AUTHORITY

South Western Division

STATION SUPERINTENDENT required at Newton Abbot Power Station. Superannuation scheme. Salary, National Joint Managerial and Higher Executive Grades Committee, Grade 5A, £1,500-£1,700.

Candidates should have received a thorough technical and practical training followed by wide experience in the operation and maintenance of generating station plant. The ability to control technical, operating and administrative staff is also essential.

Preference will be given to candidates who are Corporate Members of either the Institution of Mechanical or Electrical Engineers, or who hold an equivalent qualification.

Applications on form A.E.6/ACT, obtainable from the Divisional Secretary, 26, Oakfield Rd., Bristol, 8, should be completed and returned by 22nd October, 1957. 735

Situations Vacant (continued)

SOUTH OF SCOTLAND ELECTRICITY BOARD

Stirling Area

SKILLED ELECTRICAL FITTERS, conversant with the erection and maintenance of high-voltage switchgear, transformers and auxiliary equipment, including protection, connected with distribution networks operating at voltages ranging from 240 volts to 33,000 volts are required in this Area.

Applicants should have served a recognised apprenticeship with a transformer or switchgear manufacturer and have subsequent experience with manufacturing firms engaged on large contracts.

Conditions of employment will be regulated by the N.J.I.C. Agreement for the Electricity Supply Industry. The day wage rate for a 44-hour week is 55.5od. per hour.

Applications, in writing, should be sent to me by 12th October, 1957.

JAMES G. CURTIS,
Woodlands, Area Manager.
St. Ninians Road, Stirling. 748

PILKINGTON BROTHERS LIMITED

invite applications for a position in the Estimating Section of a medium-sized drawing office. The work covered by this section includes :—

1. The preparation of approximate estimates for buildings and plant from brief specifications and/or arrangement drawings.
2. Preparation of estimates for capital sanction from final arrangement and detail drawings. This work requires an intimate knowledge of the mechanical engineering trades and practices.
3. Valuation of plant and buildings for asset verification and fire insurance purposes.

Applicants should have some experience in one or more of these fields and should be qualified to O.N.C. standard.

The company operates a contributory pension scheme, assists with house purchases, and has excellent canteen, welfare and recreation facilities.

Applications, giving brief details of career, should be sent to the Chief Engineer, Pilkington Brothers Limited, Cowley Hill Works, St. Helens. 677

NATIONAL COAL BOARD

South Western Division

APPLICATIONS are invited for the post of GROUP ELECTRICAL ENGINEER in the No. 1 (Swansea) Area.

Applicants should have had extensive practical experience in colliery electrical engineering above and below ground and be fully conversant with electrical winders. In addition, experience in the preparation of electrical layouts, schemes for reconstruction work and power loading would be considered an advantage.

Applicants should possess at least a Higher National Certificate or its equivalent.

Salary range £925-£1,425 per annum.

Please quote Staff Vacancy No. 467.

Applicants who applied in response to Vacancy No. 241 need not re-apply.

Full particulars of age, qualifications, experience and positions held should be sent to the Divisional Chief Staff Officer, National Coal Board, Cambrian Buildings, Mount Stuart Square, Cardiff, by 15th October, 1957. 686

CENTRAL ELECTRICITY AUTHORITY

Midlands Division

DEPUTY POWER STATION SUPERINTENDENT is required at Hams Hall "C" Power Station, Lea Marston, Sutton Coldfield, Warwickshire. N.J.B. service conditions, superannuable appointment, salary in accordance with Schedule A, Grade K.3, £1,560 to £1,665 per annum.

Candidates should have a wide experience in the operation and maintenance of a large modern power station and should have sound administrative ability. The possession of a university degree in engineering or Corporate Membership of the Institution of Electrical or Mechanical Engineers will be an advantage.

Apply, quoting vacancy No. 650MD, on form AE6, available from the Establishments Officer, 53, Wake Green Rd., Moseley, Birmingham, 13, by 19th October, 1957. 736

NOTTINGHAM AND DISTRICT TECHNICAL COLLEGE

Shakespear Street, Nottingham

Principal: D. A. R. Clark, M.Sc.(Tech.), M.I.Mech.E.

APPLICATIONS are invited for the following posts :—

ASSISTANT GRADE B IN ELECTRONICS.

ASSISTANT GRADE B IN ELECTRICAL ENGINEERING.

Salary in accordance with the Burnham Technical Scale as follows : £650 × £25 to £1,025 per annum. Additions include degree allowance of £75 per annum (or £125 for good honours degree), up to 3 increments of £25 for training in approved cases and incremental allowance for industrial experience after age 21, and war service.

Further particulars and form of application may be obtained from the Principal. Completed forms should be returned not later than 5th November, 1957. 729

CHIEF DESIGN ENGINEER

MOTOR CONTROL GEAR

ESTABLISHED manufacturing company requires engineer experienced in design of contactors and auxiliaries, capable of producing, if necessary from theoretical considerations, electrically and mechanically sound designs which accord with modern manufacturing techniques.

Wide knowledge of applications essential.

Senior executive position, carrying appropriate salary, etc.

Write, giving details of age, experience and qualifications, to—Box 629.

SOUTH OF SCOTLAND ELECTRICITY BOARD

Dumfries and Galloway Area

Third Assistant Engineer (Protection) at Area Headquarters

APPLICATIONS are invited for the post of THIRD ASSISTANT ENGINEER (Protection) at Area Headquarters. Applicants should have experience in the commissioning and routine testing of protective substations and mains equipment on systems up to 33 kV.

The conditions of service will be regulated by the National Joint Board Agreement and the salary will be in accordance with Schedule A, Class G, Grade 10, £790/£835 per annum. The post is superannuable.

Applications, on the standard form, should be forwarded to the undersigned not later than 16th October, 1957.

W. H. WILLS,
Marchmount, Manager.
Dumfries. 713

NORTH OF SCOTLAND HYDRO-ELECTRIC BOARD

Northern Area

Garry/Moriston Generation Group: Vacancy for Maintenance Engineer

MAINTENANCE ENGINEER required for the above group of stations. Applicants should have received a sound technical training and have had wide practical experience in the maintenance of power station mechanical and electrical plant. Only applicants with the necessary qualifications and experience will be considered.

Salary Schedule A, Class F, Grade 7, £885/£930. Superannuation scheme applicable. House will become available at a later date.

Application forms obtainable from the Generation Engineer, Garry/Moriston Group, Auchterawe Control Centre, Fort Augustus, Inverness-shire, should be returned by 18th October, 1957. 699

CENTRAL ELECTRICITY AUTHORITY

South Wales Division
Vacancy No. 152/ER/57

APPLICATIONS are invited for superannuable N.J.B. appointment of FOURTH ASSISTANT ENGINEER in the CARDIFF TRANSMISSION SECTION.

Salary will be in accordance with Class AX/DX, Grade 6, £710-£910 per annum, of the National Joint Board Agreement.

Applicants should have had practical experience in the maintenance and operation of high-voltage overhead lines and substation equipment.

Preference will be given to candidates with qualifications leading to Corporate Membership of the Institution of Electrical Engineers.

Application forms obtainable from Secretary, South Wales Division, Central Electricity Authority, Twyn-y-fedwen Rd., Gabalfa, Cardiff, to be returned by 14th October, 1957. 685

CENTRAL ELECTRICITY AUTHORITY

London Division

APPLICATIONS are invited for the following superannuable post. Conditions of service in accordance with N.J.B. Agreement, Schedule A. Salary includes London allowance. Qualifications entitling to Graduate Membership of the I.E.E. or I.Mech.E. an advantage.

STATION SHIFT CONTROL ENGINEER, HACKNEY POWER STATION
(Vacancy No. 57/879).

Sound engineering training with some experience in control and operation of steam generating plant and main switchgear in modern power station. Salary Class H, Grade 10 = £885 plus £83 10s. shift p.a.

Applications, quoting vacancy number, to (or on form from) Central Electricity Authority, London Division, P.O. Box 136, London, W.1, by 14th October, 1957. 715

LONDON ELECTRICITY BOARD

Assistant Distribution Engineer

APPLICATIONS are invited for the above position in the Board's Eastern District at Stratford, London, E.15.

Applicants should have had a sound technical education, up to at least Higher National Certificate standard, preferably being Corporate Members of the I.E.E., and possess a practical experience of all branches of engineering work associated with the organisation of a District distribution department, particularly in regard to mains and substation work.

The post is graded under Schedule A of the National Joint Board Agreement as Class J, Grade 12, £830 per annum, rising to £885 per annum, inclusive of London allowance.

Application forms obtainable from Personnel Officer, 46, New Broad Street, London, E.C.2, to be returned completed by 16th October, 1957. Please quote ref. PER/2367/R. 582

CENTRAL ELECTRICITY AUTHORITY

Midlands Division

FOURTH ASSISTANT ENGINEER is required in the Protective Gear Section of the Technical Department. N.J.B. service conditions, superannuable appointment, salary within Schedule B, Grade 6, commencing in range £710-£835, ultimately rising to £935 per annum.

A university degree, Higher National Certificate or equivalent qualification is desirable. Some knowledge of protective gear is required, and preferably experience with a switchgear manufacturer.

Apply, quoting vacancy number 646MD, on on form AE6, available from the Establishments Officer, 53, Wake Green Road, Moseley, Birmingham, 13, by 17th October, 1957. 716

ELECTRICAL DESIGN ENGINEER

ELECTRICAL DESIGN ENGINEER required for work on special rectifiers. Applicants should hold H.N.C. in Electrical Engineering or equivalent.

Excellent canteen and welfare facilities. Five-day week. Superannuation scheme.

Apply or write: The Personnel Supervisor, Siemens Edison Swan Ltd., Brantwood Road, Tottenham, London, N.17. 678

NORTH OF SCOTLAND HYDRO-ELECTRIC BOARD

Fourth Assistant Engineer

APPLICATIONS are invited for the above post at Perth in the Chief Electrical and Mechanical Engineer's Department. The successful applicant would deal with commissioning and maintenance of generation and transmission plant and protective gear on the Board's 132 kV system, and other technical matters. Corporate Membership of the Institution of Electrical Engineers or qualifications leading to it preferred.

Salary commencing at a point within the range £710-£885 (N.J.B. Schedule B, Class AX/CX, Grade 6) depending on experience and qualifications. Superannuation scheme.

Application forms obtainable from The Secretary, 16, Rothesay Terrace, Edinburgh, 3, should be returned by 22nd October, 1957. 746

CENTRAL ELECTRICITY AUTHORITY

Headquarters, London

ONE SECOND ASSISTANT ENGINEER and one THIRD ASSISTANT ENGINEER required in the System Design and Development Sub-Branch.

The work involves preparation of designs for system reinforcement projects entailing appraisal of the practical, technical and economic aspects. Candidates should possess a recognised qualification in electrical engineering, and in the case of the Second Assistant Engineer a university degree would be an advantage.

Salaries within scales £1,210 - £1,570 and £1,105 - £1,315.

Applications stating age, qualifications, experience and present position and salary to D. Moffat, Director of Establishments, Winsley Street, London, W.1, by 25th October, 1957. Quote Ref. ER/421. 670

ELECTRICAL ENGINEER

Public Works Department, Hong Kong

DUTIES are the specification and supervision of installation, and maintenance of all electrical equipment, including motors, emergency generators, H.T. and L.T., switchgear transformers, cabling, lifts, airport lighting, domestic appliances, etc.

Appointment pensionable in the range £1,245 to £2,178 15s. plus cost-of-living allowance. Government quarters are provided if available at low rentals. Free passages are provided for the officer and his family to a total cost of 5 adult fares. Generous leave.

Candidates must be A.M.I.E.E. and have experience of air conditioning and refrigeration equipment.

Write, Director of Recruitment, Colonial Office, London, S.W.1, giving age, qualifications and experience, quoting BCD. 112/51/012. 737

COUNTY BOROUGH OF BLACKPOOL

Illuminations and Street Lighting Department

APPLICATIONS are invited for the superannuable post of TECHNICAL ASSISTANT, A.P.T. I (£575 × £30 to £725 per annum).

Candidates should be good draughtsmen with general electrical engineering experience.

Forms of application, together with details of special conditions of service which apply, will be sent on application to the Illuminations and Public Street Lighting Officer, Illuminations and Street Lighting Department, Rigby Road East, Blackpool, and completed applications must be received by him not later than 10 a.m. on Wednesday, 16th October, 1957.

ERNEST C. LEE,
Town Clerk. 674

LEGG (INDUSTRIES) LTD.

invite applications from men with suitable experience for positions as TECHNICAL SALES ENGINEERS in the Midlands and Scotland, to sell rectifying equipment and transformers.

Posts offer excellent salaries and opportunities. Write in confidence stating age, qualifications and experience to Managing Director, Legg (Industries) Ltd., Williamson Street, Wolverhampton. 702

A.E.I.—JOHN THOMPSON NUCLEAR ENERGY CO. LIMITED

Radbroke Hall, Knutsford, Cheshire

SENIOR ENGINEER. A vacancy exists for an engineer experienced in power station design and construction, with particular reference to the technical co-ordination of complete projects. He will be required to take charge of independent design office staffs either in this country or overseas. A knowledge of construction planning is essential.

The company is prepared to assist with house purchase where necessary. A contributory pension scheme is in operation.

Applications giving details of age, experience and qualifications, which will be treated in strict confidence, should be addressed to the Chief Engineer, quoting reference "J.R.M.S." 723

BRISTOL EDUCATION COMMITTEE

College of Technology
Principal: G. H. Moore, M.Sc., F.P.S., F.R.I.C.

REQUIRED, ASSISTANT (GRADE B) to teach electrical engineering and allied subjects to at least O.N.C. standard. Candidates should possess recognised qualification in electrical engineering and have had industrial and teaching experience. Duties commence 1st January, 1958.

Salary in accordance with Burnham Technical Report, £650 × £25 to £1,025 p.a. plus approved allowances.

Application form, returnable forthwith, and further particulars from Registrar, College of Technology, Ashley Down, Bristol, 7. 738

RESIDENT ENGINEER

required by the GOVERNMENT OF ADEN for the POWER STATION, FIRST EXTENSION, for one tour of 12 to 18 months.

Fixed salary £2,000 a year. Gratuity at rate of £150 a year. Outfit allowance £60. Free furnished quarters. Free passages. Liberal leave on full salary.

Candidates, over 30 years of age, must have had considerable experience in the erection and commissioning of steam power station plant, switchgear, cabling and ancillary equipment. Preference will be given to Corporate Members I.E.E. or I.Mech.E.

Write to the Crown Agents, 4, Millbank, London, S.W.1. State age, name in block letters, full qualifications and experience, and quote M2C/42324/EF. 719

The CYCLOTRON and
PROTON LINEAR ACCELERATOR
Groups at the

ATOMIC ENERGY RESEARCH ESTABLISHMENT, HARWELL

require EXPERIMENTALISTS to work on the design and construction of electronic equipment needed for experiments.

G.C.E. "A" level or H.N.C. (or equivalent); experience with pulse circuits an advantage.

Salary £1,360 - £1,630; £990 - £1,215; or £395 (at 18) to £855.

Housing, superannuation and excellent conditions.

Send POSTCARD for application form to Recruitment (941Z/48), A.E.R.E., Harwell, Didcot, Berks. 714

SOUTH WALES ELECTRICITY BOARD

ASSISTANT ENGINEER (Construction) required at Pontardulais in the West Central Sub-Area of the Board.

Applicants should have had experience of fault location and commissioning of tests on mains and equipment.

Salary Class L, Grade 13 (£835/£880) of the N.J.B. Schedule.

Applications stating age, present position and salary, qualifications, experience, and three referees, should be addressed to the Secretary (Establishments Section), St. Mellons, Cardiff, so as to reach him not later than Monday, 14th October, 1957. 671

BRITISH KLOCKNER SWITCHGEAR LIMITED

Chertsey, Surrey

TECHNICAL SALES ENGINEERS required for London and Home Counties. Knowledge of motor control gear; sales experience preferred but not essential. Apply giving full particulars to—Managing Director. 166

ARMATURE WINDERS WANTED

ONE FOREMAN ARMATURE WINDER capable of carrying out repairs and testing, also complete rewinds of all types of rotary machines, both A.C. and D.C., up to the larger h.p.'s. This situation offers a permanent well-paid position, and is situated in Lancashire. The vacancy is offered by a well-established firm of electrical engineers. Full details of past experience and an indication of salary anticipated will be appreciated.

In addition to the above appointment, JOURNEYMEN, with experience as described, are also required. Applications for these positions will also be appreciated.—Box 689.

SOUTH WALES ELECTRICITY BOARD

require an ASSISTANT ENGINEER in District 345 (Pontypridd) in the Central Sub-Area of the Board.

Salary Class E, Grade 10 (£685/£730) of the N.J.B. Schedule.

Applications stating age, present position, present salary, qualifications, experience, and three referees, should be addressed to the Secretary (Establishments Section), St. Mellons, Cardiff, to arrive by 14th October, 1957. 704

A TECHNICAL sales representative for London and Home Counties. Generous salary / commission / expenses / superannuation. Right man can earn over £1,000 p.a. Must own car. 5-day week. Only applicants with experience, initiative and dynamic personality will be considered. Full details to Man. Dir., British Central Electrical Co. Ltd., 6, Rosebery Avenue, London, E.C.1. 585

AN electrical engineer is required for a junior post in a department concerned with design and development of a wide range of electro-mechanical and electro-pneumatic equipment, and compressor and similar motors for railway braking systems. Applicants should have reached S2 or S3 level in electrical engineering, and should preferably have had practical experience in developing or testing D.C. motors. Day release may be granted in special cases to permit technical studies to be continued. Five-day week and superannuation fund. Write in confidence giving age, qualifications and experience to Personnel Superintendent, Westinghouse Brake & Signal Co. Ltd., Chippenham, Wilts, quoting reference No. Equip/N/A3. 631

ASSISTANT engineer wanted for electrical contractors in North London. Able to design, estimate, supervise and finalise shopfitting and light industrial installations. A sound permanent post for right man.—Morley's Ltd., 117, Hornsey Road, London, N.7. 679

ASSISTANT manager required for expanding transformer department. Must be capable of designing most types of transformers up to 250 kVA. Good prospects for the right man. Annual bonus scheme.—Austin Walters & Son Ltd., Ayres Road, Old Trafford, Manchester, 16. 586

ASSISTANT technical manager required by company engaged in the manufacture of rubber and thermoplastic cables. Applicants should preferably be graduates in electrical engineering or physics or hold equivalent qualifications, and should have previous experience in the electrical cable industry. Applications, giving age, qualifications, experience and salary required, to be addressed to—Personnel Officer, St. Helens Cable & Rubber Co. Ltd., Liverpool Road, Trading Estate, Slough, Bucks. 655

ASSISTANT to chief engineer required by well-known accessory manufacturers situated in pleasant north country district. A wide scope exists covering general research and development work, both in respect of the company's existing and new products envisaged. Designing ability at the drawing board stage is important, and laboratory experience together with a knowledge of electronics would be an advantage. Pension scheme. Apply in confidence stating full details and salary required to—Box 750.

BERKSHIRE COUNTY COUNCIL. Assistant engineer (electrical), Grade A.P.T. III (£845-£1,025). Applicants should have had considerable experience in all branches of electrical work and should be capable of designing schemes and preparing contract drawings and specifications for installations in schools and other large public buildings. Application forms and further particulars can be obtained from J. T. Castle, A.R.I.B.A., A.M.T.P.I., County Architect, Wilton House, Parkside Rd., Reading, to whom they should be returned not later than Thursday, 17th October, 1957. 587

***Situations Vacant** (continued)*

BRITISH ENGINE BOILER & ELECTRICAL INSURANCE Co. Ltd., 24, Fennel Street, Manchester, 4. Electrical surveyors required for various districts in Great Britain. Permanent positions carrying progressive salary scale £735 to £1,060 and non-contributory pension. Candidates, age 26 to 32, preferably with H.N.C. in Electrical Engineering or Grad. I.E.E., and with apprenticeship in manufacture or repair of electrical machinery, are invited to apply in own handwriting, stating age, qualifications and experience. 707

CIRCUIT diagram draughtsman required, preferably experienced in preparing automatic control gear schemes for interesting work with motorised pipeline valves. Applicants to have O.N.C. Electrical. Excellent opportunities for right applicant. Written applications stating experience, etc., to — Rotork Engineering Co. Ltd., Station Rd., Kingswood, Bristol. 9131

CONTRACTORS, progressive, in central London require senior designer draughtsman and also junior for electrical installations of all descriptions. Excellent prospects. Write experience and salary required.—Box 657.

CROMPTON PARKINSON Limited require a chief technical engineer at their Derby cable works. Applicants should be Corporate Members of the I.E.E. or equivalent, and should possess an intimate knowledge of the design and manufacture of paper, rubber and thermoplastic insulated cables up to and including 33 kV. The position offers exceptional scope to the right man and provides excellent working conditions with superannuation fund facilities. Applicants should provide full details of past experience and qualifications, together with salary expected. Applications should be addressed to the Director and General Manager, Derby Cables Ltd., Alfreton Road, Derby. 595

CROMPTON PARKINSON Limited require an estimator in a branch office in the South of England. Duties involve preparation of quotations for all classes of electrical equipment, including A.C. and D.C. machines, switchgear, instruments, etc. Some experience of commercial electrical engineering desirable. Excellent conditions, superannuation, etc. Applications, including salary required, to—Ref. SP, Crompton House, Aldwych, London W.C.2. 751

CROMPTON PARKINSON Limited require sales engineers for the indoor sales staff at their Chelmsford works. Applicants must have had a sound technical training and previous experience in handling enquiries relating to A.C. and D.C. rotating plant and control gear up to 1,500 h.p./kW. Superannuation scheme. 5-day week. Canteen, social and welfare facilities. Apply stating age, whether married or single and giving full details of previous experience and training to the Personnel Officer, Crompton Parkinson Limited, Chelmsford, Essex. 570

DRAUGHTSMAN or trainee for industrial contactor electric control gear for automation and related schemes, including control of machine tools. O.N.C. or equivalent qualification preferred. Permanent position. Good starting salary with excellent prospects of progressive remuneration. Write in confidence, giving full details of previous experience, qualifications, age and salary expected, to—Technical Director, Donovan Electrical Co. Ltd., Stechford, Birmingham, 33. 691

DRAUGHTSMAN required by electrical contractor in Ipswich for preparation of cable layouts. Previous experience in Air Ministry procedure an advantage.—Box 511.

DRAUGHTSMAN (senior jig and tool), experienced in the design of press tools for the mass production of precision stampings and press parts. Knowledge of progression tools and their application to dieing presses an advantage. High salary offered to draughtsman with this specialised experience. Apply in writing, giving details of experience and salary required, to—General Works Manager, M.K. Electric Limited, Wakefield Street, Edmonton, London, N.18. 690

EAST African installation contractors require supervising engineer, preferably experience abroad, aged 30/35, for general work.—Box 588.

ELECTRICAL distributors, old-established company near Liverpool Street (London) require young man with knowledge of electrical trade. As a result of expansion there are vacancies at head office, West End and Hammersmith branches for warehousemen, storekeepers, trade counter salesmen and clerks. All applications answered.—Box 661.

ELECTRICAL contractors (Newcastle) require an estimating engineer with sound practical and technical knowledge. Progressive position. Write stating age, previous experience and commencing salary.—Box 9137.

ELECTRICAL control operators required for shift work in modern industrial generating station. Applicants must have power house experience including load control and the necessary switching operations, and preferably also in parallel working with the National Grid system. Most attractive rates of pay and conditions of service. Applications in writing giving age, qualifications and experience to the Labour Manager, The Clayton Aniline Company Ltd., Clayton, Manchester, 11. 634

ELECTRICAL draughtsman, intelligent young man capable of working on own initiative. The work is variable and covers control circuit design and development. Write in first instance, in own handwriting, detailing experience to date.—Lee, Beesley & Co. (B'ham) Ltd., 41, Snow Hill, Birmingham, 4. 752

ELECTRICAL draughtsman. National Certificate standard or equivalent in electrical engineering. Experienced in electrical switchgear and distribution diagrams, automatic contactor switchgear for motor control. Previous paper mill experience preferred. Apply in writing giving details of age, training and experience to—Bowaters United Kingdom Pulp & Paper Mills Limited, Thames Division, Northfleet, Kent. 692

ELECTRICAL draughtsmen required immediately by consulting engineers in centre of Manchester for designing installations for medium-voltage distribution, lighting and power for Government buildings. Temporary engagement for at least six months, with possibility of permanent position.. Salaries up to £950 per annum. State age, qualifications and experience to—Box 680.

ELECTRICAL engineer/draughtsman required by Ashmore, Benson, Pease & Co., Stockton-on-Tees, for complete electrical installation and design work, including motor application, control scheme engineering, distribution and cabling. Experience of contract work and estimating an advantage. High salaries. Maximum assistance given in regard to housing. Grant towards removal expenses and allowance made until removal effected. Pension and insurance scheme, technical library, sports club. Apply Staff Personnel Manager. 706

ELECTRICAL engineer required for London firm of consulting engineers. Previous experience in the design and specification of installations in schools, hospitals, etc., desirable but not essential. Write stating age, salary required and brief details of qualifications and experience to—Box 512.

ELECTRICAL engineer with sound training in control gear and good connections amongst users required as senior sales assistant to general manager. Must be prepared travel extensively in U.K. Good prospects for ambitious man.—Box 618.

ELECTRICAL wholesalers require experienced representative for Birmingham area. Excellent opportunity for man with established connections. Car provided and remuneration will be by salary, commission and expenses. Replies giving full details treated in strict confidence to—Box 753.

ELECTRICIAN, London rates.—Leonard J. Ive, 29 Clarendon Rd., Watford (Phone 4030). 9136

EXPERIENCED engineer required with full knowledge of estimating for and supervising large industrial and commercial electrical installations. Applications, stating age and detail of past experience to—F. H. Wheeler & Co. Ltd., Regal Buildings, Oxford Road, Manchester, 1. 9139

EXPERIENCED meter and induction instrument designers required by Chamberlain & Hookham Ltd., Birmingham, 5. Applications giving all details of electrical and mechanical design experience, age and technical status, will receive careful consideration. An appropriate offer will be made to suitable candidates. 9122

HIGH voltage jointer required for work in South East England area. Applications are desired from jointers fully experienced with all types of plumbing and jointing on cables operating at voltages up to and including 11 kV. Conditions of service will be in accordance with the N.J.I.C. agreement.—C. Maurice Contractors Ltd., Lindsey Road, Bishop's Stortford, Herts. 663

JUNIOR draughtsman required for overhead line drawing office. Applicants should preferably be between the ages of 21 and 25 and have completed their National Service. Structural or mechanical experience will be an advantage. Summer five-day week and non-contributory pension scheme. Apply in writing, giving details of training and experience, to the Director, Design, Riley and Neate Limited, The Abbey Mill, Winchester. 732

MANCHESTER electrical contractors require an estimating engineer. Must be experienced in estimating accurately for major industrial and commercial contracts. After qualifying period suitable applicant will be invited to participate in the company's superannuation scheme. Full details to—Box 9132.

PURCHASING agent, age 25 to 40 years, is required by progressive company to purchase throughout Europe materials for a large electrical firm. Previous experience and knowledge of electrical industry essential. Reply in own handwriting stating experience, qualifications and salary required.—Box 681.

RADIO, television and electrical appliances. Departmental manager required. Annual sales £50,000. Opportunity for considerable increase in trade. Superannuation scheme (transfer clause). Applications, stating age, qualifications, etc., to the Secretary and General Manager, Wolverhampton and District Co-operative Society Ltd., 55/57, Lichfield Street, Wolverhampton, to be received not later than 19th October, 1957. 754

REPRESENTATIVE for Lancs., Cheshire and N.W. England required by manufacturers of electrical accessories, preferably with established connection with architects, consultants, hospital boards, county councils, etc., and able to drive. Age, qualifications to—Wandsworth Electrical Manufacturing Co. Ltd., Albert Drive, Sheerwater, Woking. 567

REPRESENTATIVE, resident London area, required for TEMCO accessories. Junior appointment for man aged about 25, familiar with electricity board or wholesale trade, willing to spend part time away from home. Car provided. Pension scheme. Applications, stating age, experience, remuneration expected, to—Mr. S. M. Harris, T.M.C.-Harwell (Sales) Ltd., 37, Upper Berkeley Street, London, W.1. 755

SALES manager required to set up a sales organisation in Germany and Benelux countries to market small electrical switches and circuit breakers. Applicant, preferably of German nationality, must have English language. Reply in own English handwriting stating experience, qualifications and salary required.—Box 682.

SALES representatives required for London and Home Counties. Electric cable manufacturing company, Southern England. Contributory pension and life assurance scheme in operation. Write Box 708, stating age and experience.

SENIOR engineering assistant (estab.), A.P.T. IV (£1,025 to £1,175 p.a. plus London weighting of £20 or £30 p.a. according to age). Applicants must hold a final professional qualification or an appropriate university degree. Experience in design of electrical installations to public buildings, blocks of flats, etc., would be an advantage. Application form and conditions of appointment from Borough Engineer (ER). Town Hall, Tottenham, London, N.15. Applications to be delivered by Monday, 14th October, 1957. 693

STORES and clerical assistants required. Knowledge of trade and equipment desirable. Good prospects. Pensionable.—London Electrical Co., 92, Blackfriars Road, London, S.E.1. 665

SUPERVISING electrical engineer who aspires, with justification, to become contracts manager of medium-size organisation should write giving full details to—Box 683.

TELECOMMUNICATIONS radio and line transmission engineer required by large organisation for position in technical publicity department. Applicants should be aged between 25 and 35 years and have a good general educational background with ability to write clear concise English. Some knowledge of modern telecommunication techniques, including V.H.F. and U.H.F. multi-channel systems, frequency-shift signalling practices and multi-channel carrier telephone and telegraph systems, is essential. The position is on the established staff, with contributory pension fund. Applications with full details of age, education, experience to—Box 731.

THE TELEGRAPH CONSTRUCTION & MAINTENANCE Co. Ltd. require assistant contracts engineer. Education to H.N.C. level. Experience in cable contracting. Salary £750 per annum, 5-day week. Apply to—Personnel Manager, Telcon Works, Greenwich, London, S.E.10. 694

TRANSFORMER designer (senior) required. Applicant must have wide experience in design and manufacture of units up to 250 kVA. Promotion to directorship offered after qualifying period with commensurate salary and bonus. Housing accommodation if required. Replies will be treated in strict confidence.—Stewart Transformers Ltd., 75, Kilburn Lane, London, W.10. 756

YOUNG electronic engineer required to work in design department of progressive company manufacturing electronic equipment, radio and television aerials. Laboratory experience desirable. Pension and life assurance scheme in operation. Apply stating age, experience, present appointment and salary to the Personnel Officer, Aerialite Ltd., Castle Works, Stalybridge, Cheshire. 544

YOUNG man, completed National Service, required for illuminating engineering dept. in London. Should be well educated and some technical knowledge preferred. Apply—Senior Lighting Engineer, Ekco-Ensign Electric Ltd., 45, Essex Street, London, W.C.2. 348

APPOINTMENTS FILLED

Dissatisfaction having so often been expressed that unsuccessful applicants are left in ignorance of the fact that the position applied for has been filled, may we suggest that Advertisers notify us to that effect when they have arrived at a decision? We will then insert a notice free of charge under this heading.

SITUATIONS WANTED

A.M.I.E.E. seeks new situation, wide experience in electric motor driven pumps, including control and motor design.—Box 9138.

GERMANY, Austria or Switzerland. Inspecting engineer, electrical, mechanical, wide experience, seeks permanent position. Speaks fluent German.—Box 9135.

MID-Glos. manager/supervising engineer (36), seeks employment. Experienced in preparing schemes, contract installations, power, lighting and heating.—Box 9129.

PLUMBER cable jointer, aged 34 yrs., experienced up to and including 33 kV, seeks employment on contract work.—Box 9140.

QUALIFIED elect./mech. engineer, 30 yrs.' experience techn. college to chief engineer and works manager in medium and light engineering and foundry, seeks interesting appointment. Pres. loc. Essex/London.—Box 9141.

SALES BY AUCTION

25th Sale

E. R.

By Order of the Minister of Supply

CENTRAL ORDNANCE DEPOT, BICESTER, OXON.

Important Sale by Auction by

MIDLAND MARTS LIMITED

of

GOVERNMENT SURPLUS WIRELESS, ENGINEERING, INDUSTRIAL AND VEHICLE SPARES, TOOLS AND EQUIPMENT, AND 461 VEHICLES AND TRAILERS, including

Relays, Connectors, Cable, Microphones, Headseats, Leads, Switchboards, Alternators, Rectifiers, Condensers, Transformers, Aerials, Tabby Equipment, Binoculars, etc.,

on

MONDAY, TUESDAY & WEDNESDAY, 14th, 15th & 16th OCTOBER, 1957, at 11 a.m. on each day.

View Days: Wednesday, Thursday & Friday, 9th, 10th & 11th October.

Catalogues, price 6d., to admit two to view and one on sale days, from the Auctioneers, Market Square, Bicester, Oxon (Tel. 73). 733

CLASSIFIED ADVERTISEMENTS ARE PREPAID

ARTICLES FOR SALE

DIESEL ALTERNATOR SETS

400/440 volts, 3-phase, 50 cycles

500-kVA PETTER "SS" vertical 6-cyl. water cooled Engine. Comp. air start. BRUSH Alternator. Auxiliaries, control gear, etc. 600 r.p.m.

250-kVA PETTER "SS" vertical 3-cyl. water cooled Engine. Comp. air start. BRUSH Alternator. Auxiliaries, control gear, etc. 600 r.p.m.

187-kVA WAUKESHA vertical 6-cyl. radiator cooled Engine. Eng. start. G.E.C. Alternator. Control gear. 1,000 r.p.m.

162.5-kVA CROSSLEY vertical 6-cyl. water cooled Engine. Comp. air start. L.D.C. Alternator, control gear. 500 r.p.m.

149-kVA RUSTON vertical 5-cyl. water cooled Engine. Comp. air start. L.D.C. Alternator, control gear. 600 r.p.m.

125-kVA NATIONAL vertical 6-cyl. radiator cooled engine. Comp. air start. BRUSH Alternator, control gear. 1,000 r.p.m.

100-kVA MIRRLEES vertical 3-cyl. water cooled Engine. Comp. air start. G.E.C. Alternator, control gear. 600 r.p.m.

93.5-kVA BLACKSTONE vertical 3-cyl. water cooled Engine. Comp. air start. E.C.C. Alternator, control gear. 600 r.p.m.

68.8-kVA CROSSLEY vertical 6-cyl. water cooled engine. Elec. start. BRUCE PEEBLES Alternator, control gear. 1,000 r.p.m.

62.5-kVA McLAREN vertical 5-cyl. radiator cooled engine. Elec. start. BRUCE PEEBLES Alternator, control gear. 1,000 r.p.m.

62.5-kVA PERKINS vertical 6-cyl. radiator cooled Engine. Elec. start. METRO-VICK Alternator, control gear. 1,500 r.p.m.

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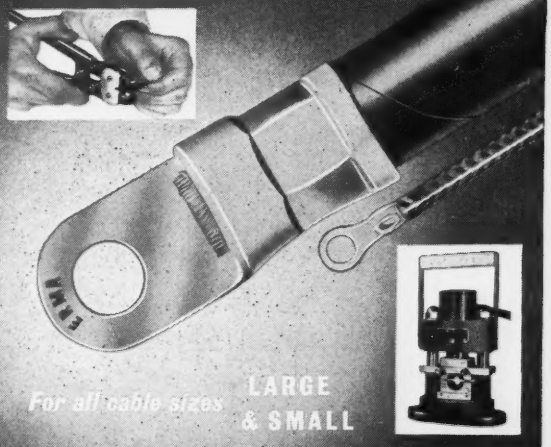

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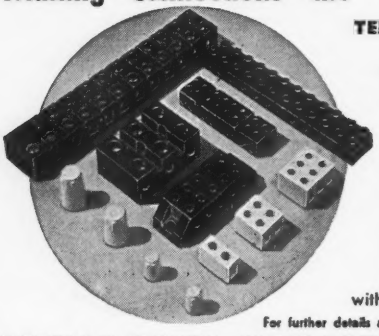

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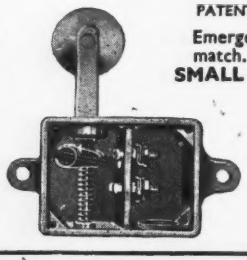

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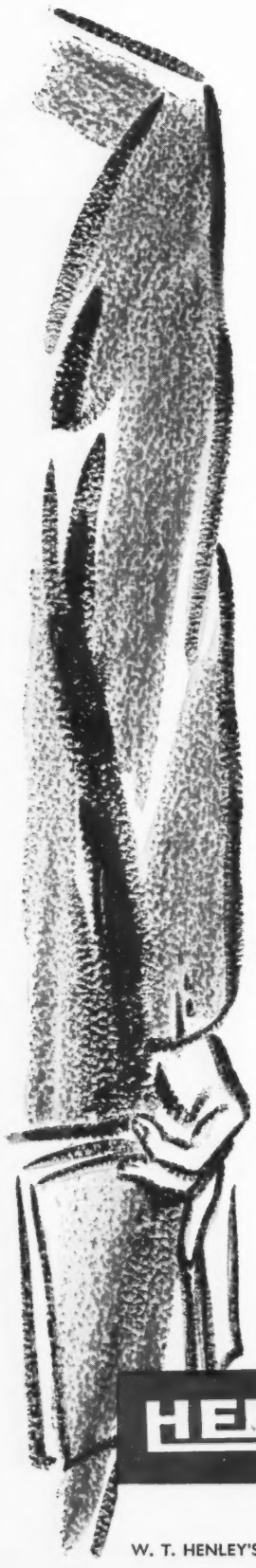

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